

ANNALS OF SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

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ANNALS OF SURGERY

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No. 1

ORIGINAL MEMOIRS.

OPERATIONS UPON THE HYPOPHYSIS.*

BY PROFESSOR DR. FREIH. V. EISELSBERG,

OF VIENNA, AUSTRIA.

RECENT investigations have demonstrated the fact that even to the smallest ductless glands must be ascribed a certain significance in the household of nature. Let me remind you of the importance of the thyroid and the parathyroid.

The hypophysis is also an important gland. In 1810, about one hundred years ago, Wenzel expressed the following opinion: "The appendix of the brain seems to play a more important rôle in the human body than one would be inclined to believe." The truth of this sentence has since been demonstrated by the investigations of our recent times, which proved that the extirpation of the hypophysis either kills the animal or injures it, and it seems that it is the extirpation of the anterior half of the gland which has the deleterious effect, because it seems to have some relation to the growth of the body, to the deposit of fat, and to the development of the genital organs. The hypophysis has also some correlative function to other ductless glands. The purpose of the posterior nervous portion of the hypophysis is hitherto unknown. I shall not enter into the discussion of the physiology of the hypophysis in this

* Read before the American Surgical Association, May 3, 1910.

paper, since Cushing has debated this point during the meeting of the American Medical Association at Atlantic City, and has added a great deal to this knowledge, showing (as he has told us during the International Congress in Budapest) that it is possible to produce a deposit of fat and a change of character of the animal by the extirpation of the anterior part.

Concerning the clinical experiences of the diseases of the hypophysis, it seems to be an established fact that a pathological increase of the function of the anterior portion of the hypophysis produces hyperpituitarism, that is, symptoms of giantism in infants, of acromegaly in adults; while a diminished function produces hypopituitarism, that is, a rapid deposit of fat in the subcutaneous tissue, a persistence of a juvenile type in younger individuals, and a decrease or loss of the genital functions in the adult.

To the first group of pathological conditions belongs the acromegaly described by Pierre Marie. It will be easily diagnosed in most cases, particularly when headache and disturbances of the optic nerve are present, and if the skiagraph is positive (as Oppenheim first demonstrated).

Besides acromegaly there is another type of disease, the adipose-genital degeneration, which has been explained as hypopituitarism. Though this type of disease has been seen before by different authors (Anderson, Schuster, Uhthoff), the first case which has been diagnosed and exactly described was observed in the outdoor department of Von Franckl-Hochwart, in Vienna, by Froehlich. The diagnosis is based upon general cerebral symptoms (headache, vomiting, epilepsy), upon changes of the optic nerve, and an adipose-genital degeneration, which means a regressive change of the breasts in women and a progressive change of this part in men, and anomalies of development of hair. Occasionally there are signs of abnormal temperature, drowsiness, and polyuria. While this observation has shown that there might be a great change of the hypophysis without causing acromegaly, post-mortem examination of patients with acromegaly has shown also the absence of macroscopic changes of the gland. Micro-

scopically, however, even in these cases a tumor has been demonstrated, as was proved lately by Erdheim.

The tumor may be a carcinoma (the hypophysis duct carcinoma of Erdheim) or a sarcoma, and finally, it may be mentioned that adenomatous and cystic tumors of benign character have been observed quite frequently.

Operative results of recent years have helped a great deal to clear up these questions. I could observe in two cases operated upon in 1907 a remarkable improvement of the complex of symptoms of hypopituitarism, and Hochenegg and Cushing had in their cases still more conclusive evidences of improvement of the acromegaly after partial removal of the tumor.

This leads me on to the treatment. The first operations on the hypophysis seem to have been performed by the brilliant English surgeon, Victor Horsley. Unfortunately I have been unable to get the details of his results. The question of the operative procedure in attacking the hypophysis has been studied on cadavers by Loewe (Berlin) and Koenig, Jr. (Altona), but has been cleared essentially by Schloffer (Innsbruck), who not only studied on a large number of cadavers the accessibility of the hypophysis, but also operated successfully in March, 1907, on a case, the first one on the continent (the patient survived the operation two and a half months). In July, 1907, I operated on my first, and in December of the same year on my second case, in both cases successfully, while a third case, operated also in December, 1907, for acromegaly, died of meningitis. In 1908 Hochenegg reported two successes. Cushing followed with one successful case, Kocher with one who survived the operation by four weeks. In addition we have to report a case of Hochenegg and one of Smoler, both of which died after the operation. In America, so far as I know, Cushing has had three, Halsted (Chicago) two, Mixter one.

So we can judge that the number of recorded cases is still quite a small one, and therefore I will give you, briefly, my own experiences.

I have operated altogether six cases, and will divide the

same in three groups. First, three cases of operations for typical hypopituitarism, all cured. Second, two cases of acromegaly, both died. Third, a combination of the first and second group, one case, considerably improved.

FIRST GROUP, HYPOPITUITARISM.

CASE I.—A man, aged twenty years, came to V. Franckl-Hochwart when eleven years of age, complaining of headache and vomiting. His intelligence and vision showed nothing abnormal. At the age of thirteen the patient grew considerably fat, and the vision of his left eye diminished. Later, also, the right eye grew dim. Examination showed a light amaurosis, right side, $\frac{5}{20}$ vision, temporal hemianopsy. Thyreoidin improved the condition temporarily, then followed a relapse, whereupon V. Franckl-Hochwart, who had kept him under observation for years, referred him to my clinic for operation.¹ On examining him, the infantile type was the most striking symptom. There was no hair on his body except on his scalp. His right eye showed atrophy of the temporal half of the papilla. The left eye genuine atrophy. The skiagraph showed an enlargement of the sella turcica. The processus clin. anteriores were visible, but the back was destroyed. These symptoms led us to the conclusion that a tumor of the hypophysis was present.

Operation June 21, 1907. Morphine-chloroform anæsthesia. An incision was made through the nose in the shape of a tuning fork, reflecting the nose to the right side, cutting through the septum, removing the turbinated bones, removing the anterior wall of the frontal sinus; these were the steps of the operation.

On account of a profuse hemorrhage the operation had to be continued in low head position. The vomer was removed, the anterior wall of the sphenoid excised, the sphenoid sinus opened, whereupon in the depth the prominence of the hypophysis became visible.² After carefully removing the thin covering of the dura I incised this membrane, and laid open the hypophysis in the exact

¹ Case reported extensively, *Neurol. Zentralbl.*, 1907, No. 21, "Operation on the Hypophysis by V. Eiselsberg and V. Franckl-Hochwart." Here cited only briefly.

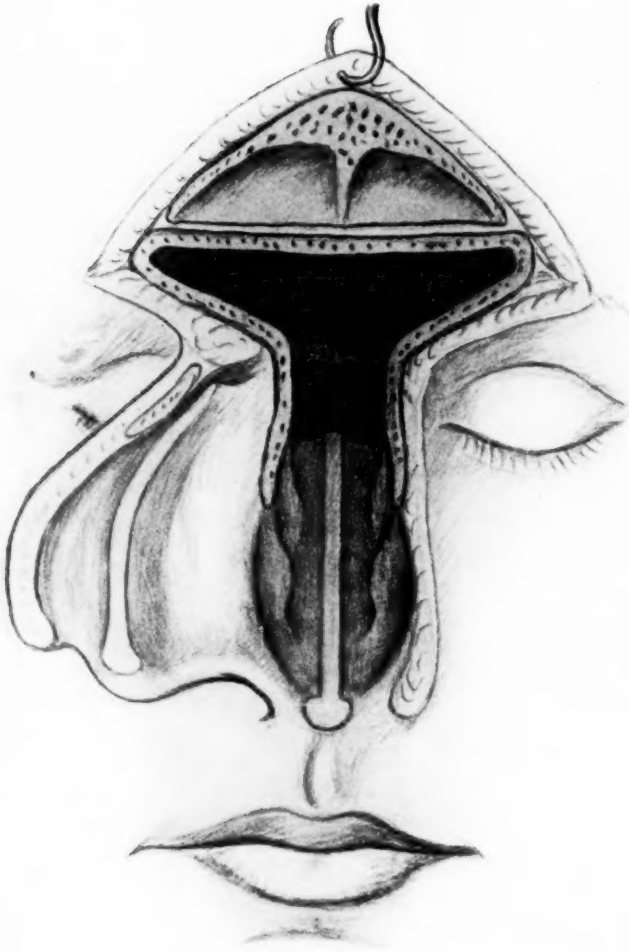
² I had studied the anatomical relations repeatedly with Prof. Tandler, who kindly assisted me, in his institute of anatomy in Vienna.

FIG. 1.



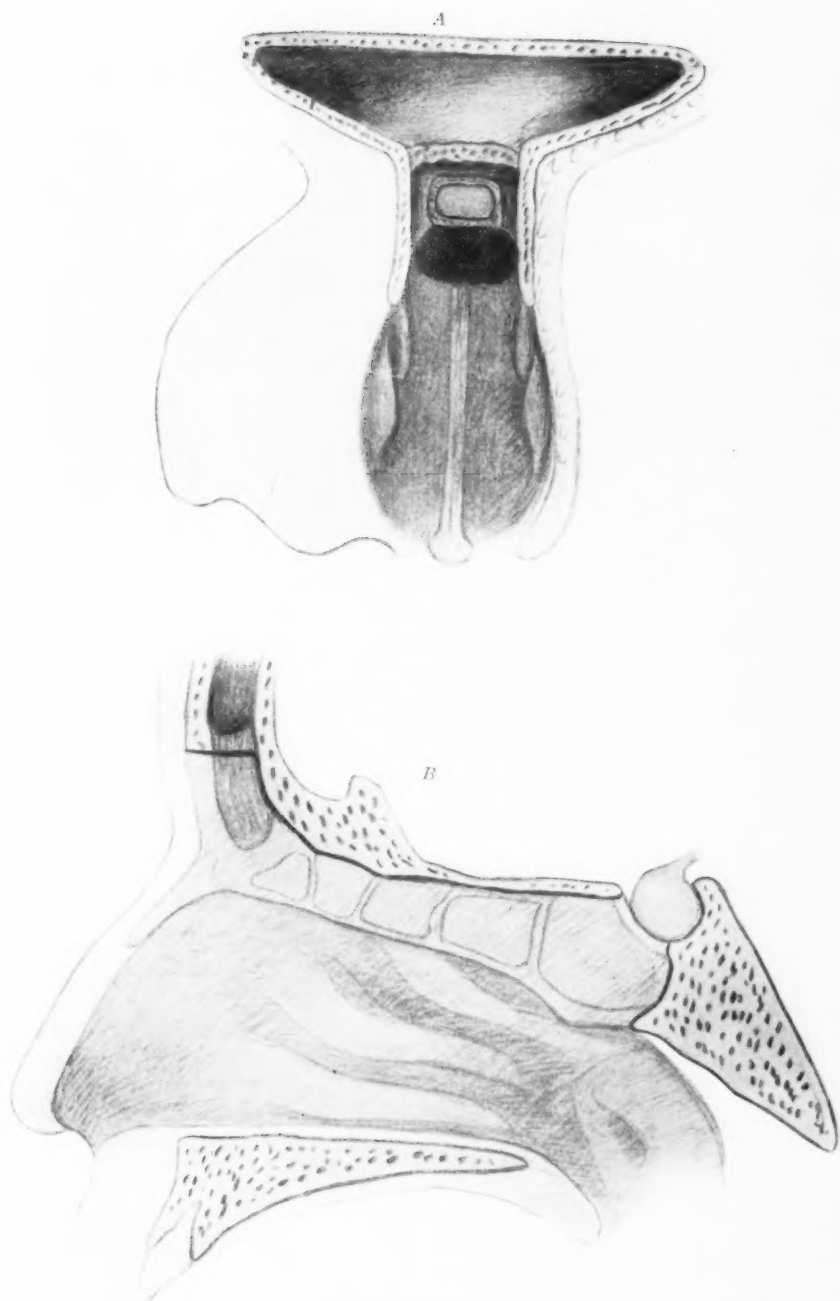
The operation on the hypophysis, lines of skin incision.

FIG. 2.



The operation on the hypophysis, the exposure of the roof of the superior fossa of the nose.

FIG. 3.



The relations of the hypophysis to the roof of the superior fossa of the nose. *A*, transverse section ;
B, anteroposterior section.

median line. A brownish-red fluid escaped and our scoop entered a larger cavity. At this moment we could see a distinct pulsation of the borders of the dura mater. Of these edges we removed particles for examination, and packed the cavity with isoform gauze. The skin incision was sutured carefully.

The patient made an uneventful recovery, with only a slight elevation of temperature in the evening.

The microscopic examination proved that the cyst had been formed by a tumor, which showed an infiltrating growth of truly epithelial character. Stoerck, of the Pathologic Anatomic Institute of Vienna, pronounced it an epithelial carcinoma, and thought it belonged to the more benign precancerous state. Whether it was formed in this locality or was a metastatic tumor could not be ascertained.

The symptomatic headache of the patient disappeared and his vision improved. He entered a sanatorium in the country where he remained under very favorable conditions for two months. It was remarkable that he lost two pounds under these conditions in the country, and particularly pleasant was the improvement of his vision. The temporal field of vision improved so much that the patient was able to go to the railroad station unassisted, and he could, after a time, resume his position as a clerk.

Two years and nine months after this operation we could establish that hair grew on his scrotum, that his general adiposity had decreased, and that his vision had remained continuously better.

CASE II.³—A man, aged twenty-seven years, a draftsman, always somewhat fleshy, has become considerably fat during the last few years. He complains of severe headache for the past three years, of double vision, and occasional vomiting for about a year. For the past few years a peculiar juvenile type is visible on the patient. His sexual appetite has disappeared entirely, and he has become gray haired rapidly of late. He is considerably fat; has no hair except on his scalp; his vision on the right side is such that he sees fingers at a distance of one metre. Bitemporal hemianopsy. The skiagraph reveals total absence of the sphenoid body and of sella turcica, and in its place is a large excavation.

³ See "Ueber einen neuen Fall von Hypophysis Operation bei Degeneratio-adiposo Genitalis," von V. Eiselsberg und V. Franckl, Wien. klin. Wochschr., 1908, Nr. 81.

Operation December 20, 1907, performed in the same manner as in the first case (according to the method of Schloffer). In exploring the hypophyseal tumor severe hemorrhage set in, which could be checked only by the use of small pledgets soaked with adrenalin. From the opening of the dura escaped a soft grayish mass, which could be scooped out and proved to be an angiosarcoma.

The healing was very favorable. After six months the headache was gone, the vision improved to such a degree that patient could read large type.

In March, 1910, two years and three months after his operation, the patient wrote me a letter that he was doing remarkably well, that his vision had improved so much on the left side that he could read newspapers without difficulty. The field of vision, however, does not seem to be increased.

CASE III.⁴—A girl, aged eighteen years, has been suffering for the past two years from vomiting and headaches, and grew fat during this time. She consulted, on account of her vision, Dr. Bichowsky, in Warschau, who found a bitemporal hemianopsy. Right side, vision of one-third; on the left side she could only distinguish fingers. Skiagraph showed an absence of the sella turcica, anterior part. This led to the conclusion that he had to deal with a tumor of the hypophysis cerebri, and he referred the case to V. Franckl-Hochwart in Vienna.

The otherwise frail patient showed a remarkable development of fat, and there was no hair on her pubes. The examination revealed type adiposo-genitalis, a bitemporal hemianopsy, and the skiagraph showed a destruction of the entrance of the sella turcica, the basis of which seemed to be only slightly changed.

Operation December 12, 1908, nearly in the same manner as in the cases described before with the only exception that, following the advice of Hochenegg, we packed the nasopharyngeal cavity and opened the anterior wall of the frontal sinus temporarily. On account of the very narrow anatomical condition of the nose the operation was quite difficult. After removing the

⁴This case was mentioned by me during a discussion in the society of Vienna physicians, and also at the International Congress in Budapest. Later on published *in extenso* by Bichowsky (Warschau) under the title "Zur Therapie und Diagnose der Hypophysis," Deut. med. Wochenschr., 1909, Nr. 36.

hypophyseal prominence we found a cyst from which we removed about two teaspoonfuls of a chocolate-brown fluid.

The microscopic examination of these contents and a part of the cyst wall gave no evidence of malignancy.

The wound healing process was extremely complicated. For a week the patient seemed to be doing well. Then, after removal of a few strips of gauze, which we had put into a small posterior opening of the frontal sinus, a violent meningitis set in, the lumbar puncture revealed pure pus, consisting of many leucocytes and a mixture of bacteria, in which a good many streptococci could be recognized. The patient seemed to be lost. We injected, however, Paltauf's antistreptococcic serum, and into the veins electrargol. In the meantime, however, the culture did not show streptococci, only a *Bacillus fæcalis alcaligenes* developed. A few days later the patient improved. Another lumbar puncture yielded clear liquor. After two months the patient recovered permanently. The vision is remarkably improved. On the right side vision is two-thirds (before the operation one-third), left side, one-tenth (before the operation only movements of the fingers could be discerned). Two months after the operation patient menstruated for the first time, but the menses have not reappeared.

Now (March, 1910) she is absolutely normal, except that we find a temporal hemianopsy on the left side.

SECOND GROUP, ACROMEGALY.

CASE IV.⁵—Working woman, aged thirty-three years. Shows for the past eight years signs of typical acromegaly. During the last few months disturbances of vision and severe headaches set in. On admission to the hospital she shows the typical picture of acromegaly. Examination of the eyes yields bitemporal hemianopsy.

She is very anxious to be relieved of her intolerable headaches by a quick operation, which, is, however, postponed on account of a nasal catarrh, and she is sent home until this condition improves. After ten days, however, she returned and begged to be relieved of her headaches.

I am sorry I yielded, and undertook the operation December 17, 1907, in a manner described in the former operations. The

⁵ Case mentioned Wiener klin. Wochschr., 1908, 31.

removal of the tumor of the hypophysis brought forward grayish-red masses, which proved microscopically to be a sarcoma.

The same evening clear symptoms of meningitis set in, which led to an exitus in forty-eight hours.

Postmortem showed a basal sarcoma, extending clear up to the frontal lobes, from which a piece corresponding to the hypophysis has been extirpated. The case was from the start an inoperable one.

CASE V.—Woman, aged forty years; never had any children. Ten years ago she suffered from severe headaches, which improved after a duration of six months, whereupon a diplopia set in. Nine years ago she showed the first symptoms of acromegaly—insomnia, headaches, and disturbances of digestion. Arsenic and thyreoidin improved the condition only temporarily. For the past six months her condition grew worse, particularly the headaches.

On admission the patient exhibited the typical symptoms of acromegaly with the normal field of vision. On the right side there were some old corneal opacities, with a scotoma on the outside. The vision of the left side is, corresponding to the opaque condition of the cornea, one of an irregular astigmatism. The examination of the nose revealed a chronic catarrhal condition. The skiagraph shows an enormous dilatation of the sella turcica without destruction on the outlines. Very large sphenoidal sinus.

For a number of days the patient had received urotropin, as recommended by Cushing, before I operated on March 9, 1910, in the same manner as before.⁶ The operation was very simple, and completed in less than an hour. The dura was incised, and from the region of the hypophysis a tumor mass removed, which was carefully examined by Stoerck in the Pathological Institute of Vienna and pronounced parietal sarcoma, by Erdheim as carcinoma of the hypophysis.

Already the day after the operation headache and elevation of temperature appeared. A typical meningitis set in, which caused death after three days.

The postmortem showed recent suppurative meningitis (streptococci) on the basal surface as well as on the convexity of the brain. The largest portion of the tumor had been removed by the operation, only small particles were left on the operculum of the sella turcica. Some pneumonia in the lung.

⁶ Temporary opening of nose and sinus frontalis.

THIRD GROUP, MIXED TYPE.

CASE VI.¹—Tinsmith, aged thirty-six years, married, father of healthy children; noticed five months ago that his left eye became weaker, and within three months he became blind on that side. At the same time he had intense headaches; the right eye also became worse in its vision. For the last year he had impotency. These symptoms and a skiagraph which showed a distinct enlargement of the sella turcica, with destruction of the outlines of the same, led Archibald Church, of Chicago, to diagnose a tumor of the hypophysis, and he advised an operation. Patient came at first into the clinic of Prof. Fuchs in Vienna with his eye trouble. Diagnosis of choked vision in both eyes and a clear, temporal hemianopsy on the right side was established, and the patient referred to my clinic.

He did not exhibit any apparent symptoms of acromegaly, but manifest deposit of fat in his subcutaneous tissue. The skiagraph was in accord with the diagnosis of Dr. Church.

January 16, 1909, the operation was performed in a similar manner as previously, and it proved more difficult than any other because the prominence of the hypophysis was hardly visible in the sphenoid sinus. The hypophysis itself was transformed into a large tumor which could be scooped out thoroughly.

The microscopic examination proved it to be epithelial carcinoma.

The course of the wound healing was normal, but the patient gave us a great deal of worry on account of his drowsiness, as it appeared to us as if he was suffering from an abscess, until finally these symptoms disappeared, and the patient could be transferred into the clinic of Professor Strümpell. He improved in a very short time, but his physicians noticed that his fingers and the anterior parts of his feet became visibly smaller. This was not only caused by the disappearance of his fat after the operation (he lost 20 kilos), but even his clothes which he had worn before his sickness seemed remarkably longer; for instance, his trousers were four centimetres too long, the foot three centimetres shorter, as

¹This case is identical with Case IV in the article of Archibald Church, "Pituitary Tumor in its Surgical Relations," Jour. Amer. Med. Assoc., July 10, 1909.

his shoes, which had been fitting closely before the operation, proved by actual measurement. His gloves appeared a good deal larger around his wrist, and the fingers seemed about the width of the finger shorter than before in the glove. The stiff hat of the patient falls down over his ears. His size of 39 centimetres is diminished by three centimetres.⁸

It seems to me important that the patient who has been impotent for two years has erections in the morning for the first time. The intelligence of the patient has improved, and of his drowsiness we cannot notice anything. His headache has disappeared. The least improvement is in the vision of the patient. His left eye has remained blind. His right eye has slightly improved, but the field of vision is still contracted. Patient left in March, 1910, for Chicago, where I saw him recently. He complained about rheumatic pains in his right shoulder.

I have as you see, operated six times on the hypophysis.

I can state, by the way, that I have seen a case of a boy shot in the head, where the bullet seemed to be lodged in the hypophysis. This is a year ago, and the child has shown no symptoms of dyspituitarism.

While in my first three cases of operation on the hypophysis an improvement of the symptoms of the adipose-genital type (disappearance of the obesity, reappearance of hair, reappearance of sexual function) was noticed. Both cases of acromegaly died shortly after the operation. Particularly interesting is Case VI, in which before the operation acromegaly was not manifest, but after the operation the remarkable decrease of circumference of the head, of the size of hands and feet, could be recorded. While this patient, notwithstanding his good nutrition, has lost 2 kilos, I must say that I believe it is a combination of both types. We can also imagine that through the growth of the tumor some parts of the anterior portion of the hypophysis were irritated, while other parts were destroyed. It is the question whether it would not be more rational to change the term of hyper- and hypopituitar-

⁸I refer for the detail of these conditions, which appear so late after the operation, to the discussion of Dr. Stoerck, in *Sitz. der Ges. f. Inner. Med.*, November, 1909.

ism into dyspituitarism. So far as the microscopic examination of my cases is concerned we found: twice (Cases I and VI) an epithelial carcinoma; twice (Cases II and IV) sarcoma; once (Case V) carcinoma or sarcoma; once (Case III) a cyst.

It is interesting, furthermore, that both cases of acromegaly exhibited a typical malignant growth. In one case it was so extensive that it involved the frontal lobe. The hypophysis which was removed during the operation was all transformed into a tumor mass. Also in my second case were signs of distinct malignant growth. In both cases, notwithstanding the positive presence of a malignant growth, symptoms of acromegaly were dating back for years, so that we had to conclude that these malignant tumors had grown remarkably slowly, a conclusion which seems to be hard to believe considering the malignant structure of the tumors. Altogether we find a remarkable discrepancy in the comparison of the postoperative course and the microscopic findings. We do not operate radically, even do not intend to do more than to diminish the size of the tumors, or remove the contents of a cyst, and nevertheless we notice such remarkable improvement which we are not accustomed to see in our operations on other parts of the body when we have done such an incomplete operation. We must draw conclusions from this that it is particularly the pressure which has been exerted by the tumor upon the remaining parts of the hypophysis, and which has produced the dystrophy (compare Hildebrand's case). But it is altogether remarkable that my first case, which was operated on almost three years ago, has shown a permanent improvement, and similar seems to be the course in Cases II and VI.

A few more remarks as to the technic of the operation. The hypophysis can be exposed by the intracranial route, or through the nasal or buccal cavities. The former method is by far the more difficult, because we have to exert some pressure upon the brain nerves, and we may injure one of the large vessels. Whether the method which Biedl and Karplus have employed in monkeys of late, in which the brain in Rose's position can be pressed forward half a centimetre, so that the

nerves are not injured, is also applicable for man, must be left an open question. At any rate, the intracranial route is heretofore regarded as the more difficult, the nasal route the easier, although it offers a greater danger of infection. We have to pass on our way to the hypophysis through a region saturated with microbes. It is well known that a simple cold immediately increases the virulence of a large number of micro-organisms, which are not innocuous for the meninges, and I could, to my sorrow, confirm this in my two cases (IV and V), particularly in Case IV, in which I gave in to the patient's demand to operate during a severe cold. Perhaps the chronic catarrh of the nose may be regarded as a constant companion of acromegaly. At any rate, we have to pay attention to catarrhal conditions in such cases. In my fifth case I think I made the mistake that I did not remove enough of the inferior turbinate, so that the cavity became very irregular and easily exposed to infection. In Case III the symptoms of meningitis set in with such a stormy manner, although we had found only a cyst. When my lumbar puncture produced pus in this case I had lost all hope for the patient. But fortunately the virulence seemed to have been a very low one, and the patient passed this danger. At any rate, we have to consider meningitis in the operation on the hypophysis, as I have had two deaths in six cases from this cause; that is by far a much larger percentage than we have in brain operations through the cranial cavity.

Only very few operators have attacked the hypophysis by the intracranial route (Horsley, McArthur, Krause, Borchardt). The majority of operators have used the nasal route. I followed in my operations essentially Schloffer's method. The method developed by Moskowitch, under the supervision of Tandler in the Anatomical Institute of Vienna, by which the anterior wall of the frontal sinus is definitely removed, and which was modified later and used successfully on a patient by Hochenegg, in a manner of a temporary resection, is already proposed in Schloffer's work on this subject. This temporary resection is cosmetically a great improvement.

The method which I followed in the last cases was as follows:

Prophylactic use of urotropin according to Cushing's suggestion, anæsthesia, packing of the nasal cavity (to prevent the operation in a dependent head position—Hochenegg), temporary resection of the nose and reflection to the right side, whereby the vomer is cut as far back as possible so as to prevent saddle-nose later on, temporary resection of the frontal sinus, total removal of the contents of the nasal cavity, including the posterior part of vomer and turbinated bone, exposure of the anterior wall of the sphenoid sinus, opening of the same, whereby the hypophysis prominence is laid bare. The lamp of Zeiss or a very good head mirror is absolutely necessary. The opening of the sella turcica must be made in the exact median line and not too much anteriorly, to prevent an injury of the carotids and the chiasma. After removal of the tumor or scooping out of the cyst ⁹ we introduce drainage, pack the nasal cavity,¹⁰ and suture the skin exactly. The tendency of surgeons now is to perform this operation with least destruction of bones. Kocher¹¹ states, and it seems to me not unjustly, that the temporary resection of the anterior wall of the sinus frontalis is not necessary to lay bare the hypophysis.

Following the very good anatomical research from Kanaval,¹² the infranasal route for reaching the tumors of the pituitary body is proposed. Halsted, of Chicago, performed this operation twice (once with success). Mixer¹³ operated by reflecting the nose toward the front; the scar was scarcely to be seen. Hirsch (Vienna) removes the contents of the

⁹ We can hardly ever remove the entire hypophysis, as Cushing has shown by his animal experiments that after the most radical removal a thin veil of the anterior portion remains behind.

¹⁰ I shall use in the future, instead of the vioform or isoform gauze, the old iodoform gauze, which seems to have more disinfecting activity.

¹¹ *Deutsche Zeitschrift f. Chirurgie*, Band c.

¹² "The Removal of Tumors of the Pituitary Body by an Infranasal Route," *Journal of the American Medical Association*, November, 1909.

¹³ The cases of Halsted and Mixer were demonstrated at the meeting of the American Surgical Society, May 3, 1910.

nasal cavity in many sittings, and the same method seems to have been followed by West.

I had the pleasure of witnessing recently an hypophysis operation performed by Dr. Cushing, whose technic (similar to that of Kanaval and Halsted) impressed me so favorably—as it avoids as well any bone lesion as any incision of the skin—that I have decided to give it a trial on the next occasion. Still, I would mention that the scar in my last cases did not cause a too great deformity. It also seems to me that temporary resection, at least, of the nose, giving as it does a larger access to the field of operation, must in certain cases be of decided advantage.

We shall be able to achieve more in regard to vision only when the family physicians shall refer their cases earlier to the surgeon for operation. According to V. Franckl-Hochwart, the time of development of acromegaly, as he was able to glean from his observations of 124 cases, is a very long one, extending over many years, but the prognosis is only bad with regard to the vision. The operation must be regarded as a dangerous one as yet, but I believe that if we tell a patient that his malady continuously will get worse and finally lead to blindness, that he will rather submit to a very dangerous surgical procedure than to keep on doing nothing, and lingering into absolute helplessness.

TUMOR OF THE HYPOPHYSIS (WITH INFANTILISM).*

OPERATION—RECOVERY (PRELIMINARY REPORT).

BY SAMUEL J. MIXTER, M.D.,

AND

ALEX. QUACKENBOSS, M.D.,

OF BOSTON, MASS.

(Pathological Report by F. H. Verhoeff, M.D.)

ON the 12th of October, 1909, Charles A., twenty-seven years of age, born in Massachusetts, came to the Massachusetts Charitable Eye and Ear Infirmary for failing eyesight.

Family History.—His father is living and in good health, his mother has been dead a number of years. He is the youngest of five children, four of whom are living and well. One died of peritonitis. His brothers, three in number, are about his size, but heavier.

Previous History.—In childhood had the ordinary diseases, but never had diphtheria or scarlet fever. His growth was gradual, and he does not recall growing fast at any period, or that he has grown any during the past ten years. He thinks that the hair began to appear on his face and on his pubes at about the age of fourteen. He has never had to shave oftener than once a week. He gives his height as five feet six inches, and his usual weight as 130 pounds, although for the last year he has only weighed about 126 pounds. For the past five years his work has been in-doors, part of the time as elevator boy, the remainder as bell-boy.

He uses alcohol and tobacco, and thinks that his sexual powers are good.

Present Illness.—The present trouble possibly made itself manifest about five years ago; at that time he had headaches which he thought were due to eyestrain. Three years ago he had trouble with his eyes which was relieved by a glass. Six-

* Reported to the American Surgical Society, May 3, 1910.

teen months ago he had difficulty in using his eyes; from his story it sounds as if he had "diplopia," and he was told that he had "muscle trouble" and was given prisms. He now recalls that he had difficulty in seeing to either side at that time. About the same time he had an attack of rheumatism with stiffness in hips, knees, and ankles, but with no pain. Recovery was prompt under treatment. Six weeks ago he became head bell-boy, and this change required more use of his eyes, including some clerical work. He then noticed that his vision was blurred, and it soon failed so that he had to give up his position.

Physical Examination.—The patient is of medium size and has the appearance of a boy about eighteen, his face is smooth, fairly full, unlined, and asymmetrical. He has a peculiar pallor which would attract attention at once. The hair of the head is soft, thick and fine, that on his face is soft and scarcely shows on his chin, although he has not shaved for two weeks. His voice is not remarkable, certainly not feminine, although his speech is slow and moderate. Adam's apple not prominent. The skin upon the neck is smooth, white, and well padded. There is no hair upon the chest or in the axilla, and the pubic hair is rather thin and cut off horizontally at the pubes.

The teeth are normal and the hard palate high and narrow. The hands are rather large for his size, the fingers long, a little tapered, and spread at the tips. The penis is rather less than normal size, and the testicles are small. In shape the patient is rather womanly, especially upon a side view, the back is hollowed, and the hips are prominent. Heart, lungs and abdomen, negative. Urine normal.

Blood, 5,000,000 red, 18,000 white, hæmoglobin 70 per cent., blood-pressure low.

Eyes: The vision in the right eye is 8/200, in the left eye 6/200. There is bitemporal hemianopsia. The fundi show well-marked optic atrophy, the optic nerves are pale, sharply defined, and show no signs of a previous neuritis. The retinal arteries are rather small. The pupils react. The X-ray shows an enlargement of the sella turcica.

While under observation there was little change in the patient's condition, his vision remained about the same, his speech became a little slower, and there was a gradual loss of weight. At no time did he complain of headache. He is rather easily

FIG. 1.



Skiagraph of skull, transverse view, showing relations of sella turcica.

upset, on several occasions while being examined he became very pale and had an attack of diarrhoea.

The medical treatment consisted of strychnine sulph., Bland's pills, and injections of citrate of iron. The hæmoglobin rose to 90 per cent.

OPERATION Dec. 27, 1909, by Dr. Mixter: Patient in dorsal position, posterior nares packed, and ether given with Fillebrown apparatus. The operation performed was that described by Dr. A. B. Kanaval (*Jour. A. M. A.*, vol. liii, p. 1704-1707). After making the U-shaped incision beneath the nose, the nasal processes were divided with a chisel and the nose forcibly turned upward and held by a stitch through the septum and forehead at the line of the hair. The mucous membrane was separated from the bony septum which was cut away, and with right-angled retractors a good view could be obtained of the upper part of the vomer where it is attached to the sphenoid. This was evulsed, opening the sphenoid cell. Up to this period there was fairly free hemorrhage, but packing with adrenalin gauze and the pressure of the retractors soon controlled it.

The sphenoidal cell was shallow, and on thrusting a blunt instrument through what appeared to be its posterior wall a gush of slightly turbid, cholesterin-laden fluid filled the field of operation. There was at least an ounce and a half of this fluid. The opening into the cyst (*sella turcica*) was enlarged with Mosher forceps, and the cavity was swabbed out with gauze, packed with a cigarette wick brought out through the nostril, and the wound closed. A gauze pack was placed in the other nostril to hold the septum in place.

An electric head light was used during the operation on the deeper parts, and during the last of the operation even the retractors could be removed without obstructing the view, so thoroughly had the mucous membrane and the turbinates been pressed back.

Recovery from the operation was rapid, although he had a slight erysipelas of the face.

The Kanaval operation was selected after numerous experiments on the cadaver and proved to be most satisfactory and simple. The distance from the lower part of the nasal opening is very slightly greater than from the upper part, and this is more than compensated for by its width, and the fact that

nothing but the vomer has to be removed in order to reach the sphenoidal cell, all other parts, including the turbinates, being easily held back with retractors. There was no bleeding into the mouth or throat and tracheotomy or the Roux position was unnecessary.

Postoperative History.—Following the operation there was a gradual improvement in sight, on January 23, 1910, the vision in the right eye was 20/30—, in the left eye 20/50+, the hemianopsia still persists. He was discharged from the hospital on February 15, 1910, with vision and fundi about the same as at last record. Following his discharge from the hospital he had an attack of rheumatism in his arms and legs, which lasted about six weeks, two of which he was confined to the bed. Under salicylate of soda this finally disappeared. On April 11, 1910, he reported that he was "feeling fine," he had gained 20 pounds, and was able to read without any difficulty. His vision in the right eye was 20/30+, in the left eye 20/40+. Temporal hemianopsia. Examination of the fundi shows little change with the exception that the optic nerves may be of better color.

There is loss of sensation in the upper lip, and at times there is a slight watery discharge from the nose.

PATHOLOGICAL EXAMINATION by F. H. VERHOEFF, M.D. (From the Pathological Laboratory of the Massachusetts Charitable Eye and Ear Infirmary.)

The fluid submitted, 8 c.c. in amount, is odorless, slightly bloody, and contains an abundance of glistening particles. After sedimenting, it has the appearance and consistency of blood-serum. Under the microscope the glistening particles have the characteristic rhombic form of cholesterin crystals. There are a considerable number of red blood-corpuscles and a few white cells. Some of the cells are filled with fat droplets (not dissolved by acetic acid). Fat droplets are also found free in the fluid. Stained films from the gauze which had been rubbed into the cyst show a few pus cells and some epithelial cells. There is no broken down blood. The fluid does not undergo spontaneous coagulation, but is coagulated solidly by heat.

The tissue submitted for examination consists of a small piece of membrane, about 2.5 mm. x 2 mm. x 0.5 mm. in size, removed from the cyst wall on a swab. Before fixing in Zenker's fluid the membrane was spread out on a piece of paper so that exact cross sections could be made.

On microscopic examination the specimen is found to consist chiefly of epithelium. Within the epithelium there are numerous spaces, which as will be shown, are not glandular but stroma spaces. One surface of the epithelium has a smooth outline with occasional sharply defined

depressions, and is coated with serum. This is evidently a free surface which bounded a cyst cavity. The opposite surface is ragged and corresponds to the place of fracture in the removal of the specimen. The cells along the free surface are columnar in form, and at first glance might be mistaken for those of glandular or ciliated epithelium. Staining with Mallory's phosphotungstic acid hæmatoxylin, however, fails to show the fenestrated membrane characteristic of the latter, but does frequently bring out, running between the cells, intercellular fibrils of Herxheimer. Moreover, in places a distinct basement membrane may be made out as the immediate boundary of the cyst, which gives the reaction of collagen by Mallory's and Van Gieson's methods. The columnar cells along the cyst wall are, therefore, undoubtedly analogous to the basal cells of epidermis.

Below the surface, at different depths, the spaces are encountered. These are of various sizes, rounded or irregular in shape, the irregularities often being due to projections or infoldings of the epithelium into them. Around these spaces the epithelial cells almost invariably assume a columnar form. These columnar cells, just as those on the free surface, fail to show a fenestrated membrane and do show still more plainly intercellular fibrils and a basement membrane of connective tissue. Between the cells and this membrane definite fibroglia fibrils often occur. This columnar epithelium is therefore not glandular, but represents basal cells abutting on stroma. There are, in fact, no glandular lumina in the specimen.

Occasionally, owing apparently to the complication of its growth, whorl-like formations occur in the epithelium, but these never contain keratohyalin or other degeneration products. In places, especially near the free surface, definite prickle-cells occur. No mitotic figures are found after fairly prolonged search.

The stroma spaces contain connective tissue, blood-vessels, colloid material, and peculiar cells filled with globules. Most of them contain more or less of all these elements. In addition eosinophilic leucocytes are not infrequently encountered. Some of the spaces contain also serum, fibrin, and red blood-corpuscles, due probably to the trauma of the operation. A few of the spaces contain only delicate fibrillated connective tissue with a few stellate cells and single blood sinuses near the centres. In a few of the small spaces the stroma is uniformly hyaline. Other spaces are filled with globulated cells alone, and others still are apparently empty. The connective tissue is least where the globulated cells are most numerous, but the basement membranes persist after the rest of the stroma has disappeared. In some of the spaces where the globulated cells are abundant a new formation of connective tissue has occurred, the spaces here being pervaded by new formed fibroblasts accompanied by collagen and fibroglia fibrils.

The globulated cells each shows a round nucleus with one or two nucleoli, while its cytoplasm is usually entirely replaced by large globules of fairly uniform size. The globules are situated in a cell reticulum which stains in acid fuchsin. The globules themselves fail to stain in any

of the usual stains, but retain a more or less decided yellow color, which they show in unstained specimens. Some of these cells packed with globules reach comparatively enormous proportions. In these the nucleus is pycnotic or is absent. Suitable stains show in the cells with only one or two globules, or similar cells free from globules, centrosomes contiguous with the nucleus.

Careful study of the specimens shows occasionally these globules and reticulum in an epithelial cell bordering on a space. These cells are never much enlarged, and the globules do not replace the cytoplasm entirely. In no instance can one of these cells be found in the act of entering or discharging its contents into a stroma space. In one situation proliferation of flat cells lying along and internal to the basement membrane can be made out. Whether these are epithelial or endothelial cells it is impossible to determine.

The colloid material occurs in the stroma spaces usually as rounded masses. Often they completely fill the space so that they are closely surrounded by epithelium. It does not seem that the colloid material is ever directly formed by the epithelium, however. In some places where the colloid bodies are massed together, the epithelium has grown in between them from the periphery. Occasionally one of the bodies is surrounded by a foreign body giant cell. The colloid material, apparently according to age, stains from pink to dark blue in hæmatoxylin-eosin, reddish to blue in Mallory's connective-tissue stain, and yellow to red in Van Gieson's stain. Some of it has evidently undergone calcification. Under the high power it appears finely granular and sometimes shows concentric lamination. It appears identical with the colloid excrescences of the pigment epithelium of the retina. Occasionally some of the yellow globules above described, and degenerated cell nuclei, are found within them, indicating that they are formed from the globulated cells.

DIAGNOSIS: Congenital epithelial tumor of hypophysis cerebri with cystoid degeneration.

REMARKS.—It is certain that the fluid examined represented the contents of a large cyst from the facts that it was loaded with cholesterin crystals, that it had the appearance and consistency of serum, was coagulable by heat, and that it contained epithelial cells. It is almost equally certain that the piece of solid tumor tissue removed formed part of the immediate wall of the cyst because of the smooth uninjured surface presented by one side of it. For this reason, as well as for those already given, it is clear that the cyst was not glandular in nature but a dilated stroma space in which the stroma had degenerated and disappeared. That the tumor was derived either from the hypophysis in embryo life, or from some congenital anlage having the potentiality of an hypophysis, is indicated by its situation,

its epithelial nature, and its structure. In structure it shows a remote similarity to the invaginated epithelium of the buccal epithelium forming the embryo hypophysis, and its origin from buccal epithelium is further indicated by the occurrence of prickle-cells in places.

Another strong argument in favor of the tumor being an analogue of the hypophysis is that in this situation in the embryo there is no other epithelial invagination which occurs. The only other congenital epithelial tumor which might reasonably be expected to occur here, aside from true teratomata which may occur anywhere, is the chordoma. The notochord, however, never contains epithelium similar to that in this tumor—the resemblance of its tissue to epithelium is always remote. It never shows basal columnar cells nor prickle-cells.

The nature of the globulated cells in the stroma of this tumor is not clear. I have failed to find similar cells in either the adult or embryo hypophysis. The round cells containing them are similar to endothelial cells, yet the fact that the globules may be found in epithelial cells abutting on the stroma suggests that the globulated cells in the stroma spaces are of epithelial origin.

The histological structure of the tumor seems to show a certain analogy to that of the congenital tumors of the salivary and lachrymal glands known usually as mixed tumors, especially to those presenting a cylindromatous structure. For here, just as in a cylindroma, there are stroma spaces bordered by basement membranes of connective tissue and fibroglia, in which the stroma shows various stages of degeneration. The character of the degenerative change is in general different from that in a cylindroma, but this is no doubt due to a different embryonic relationship. Nevertheless, some of the spaces show a typical hyaline change. The fact that the epithelium contains epithelial fibrils and prickle-cells is no doubt due to its origin from buccal epithelium. Here again there is an analogy to a cylindroma, for as I have shown elsewhere,¹ the latter tumor may produce these structures also. In some cylindromata I was able to demonstrate minute glandular lumina in the epithelium around the stroma spaces, but these are absent in this tumor.

¹“The Mixed Tumors of the Lachrymal and Salivary Glands,” *Journal of Medical Research*, Feb., 1905, p. 319.

The question whether the tumor was actually connected with the adult hypophysis is relatively unimportant. It may have arisen from a separate infolding of the embryonic buccal epithelium. Such an origin would be analogous to that of many tumors of the lachrymal gland which arise, not from the normal gland, but in close proximity to it.

If the above interpretation of this tumor is correct, such tumors should not be classed with the teratomata, but with the more simple epithelial or mixed tumors of congenital origin. Since a suitable term which includes this whole group of tumors is apparently lacking, I would suggest the term *congenital epitheliomata*. This term emphasizes their two most important features, namely, their congenital origin and their essentially epithelial nature. As I have pointed out elsewhere, even when these tumors consist chiefly of cartilage they are yet essentially epithelial so far as their origin is concerned.²

The prognosis for this group of tumors and therefore presumably for the present tumor is favorable as regards the likelihood of metastases, but unfavorable as regards local recurrence or increased growth after operative interference. In this particular case, however, the tumor was not greatly traumatized, so that it may retain its previous inactivity.

²In the Journal of the American Medical Association, Sept. 25, 1909, Dr. Hecht has reported a tumor of the hypophysis pathologically examined by Dr. Herzog, sections of which they have kindly sent me. This tumor in certain details shows little similarity to ours, yet in all probability it is essentially of the same nature and also belongs, as Dr. Herzog contends, to the simple mixed tumors that I would call congenital epitheliomata. It shows one remarkable and striking feature which I would interpret differently from Dr. Herzog. By rather abrupt transition the basal columnar cells of the epithelium become converted into a network of stellate cells with communicating processes, thus forming a syncytium. Dr. Herzog describes this as connective tissue. This syncytium appears identical with that of a developing tooth or adamantinoma. The embryonic notochord also shows a similar syncytium, but the tumor in no other way suggests a chordoma. Dr. Herzog states that this tumor contains no neuroglia, but in the specimens sent me I am sure that the stroma consists almost entirely of neuroglia similar in appearance to the *pars nervosa* of the adult hypophysis. In the Van Gieson specimen this tissue gives the yellow staining reaction of neuroglia, in contrast to the pink stain of the tissue accompanying the blood-vessels.

CLINICAL EXPERIENCES WITH INTRATRACHEAL
INSUFFLATION (MELTZER), WITH REMARKS
UPON THE VALUE OF THE METHOD FOR
THORACIC SURGERY.*

BY CHARLES A. ELSBERG, M.D.,

OF NEW YORK.

DURING the past year Meltzer and Auer¹ have described a method of artificial respiration which they call "respiration by the continuous intratracheal insufflation of air." A small tube was passed through the larynx into the trachea almost to the bifurcation, and by means of a foot-bellows air mixed with ether was blown almost continuously through the tube under a pressure of 15 to 20 mm. of mercury. By this means the lungs remained distended, the excess of air passing upwards in the trachea and out through the larynx and mouth in an almost continuous stream. One or both pleural cavities could be widely opened and the animals could be kept alive for many hours. The animals remained alive and in good condition even when deeply under the effects of curare so that all respiratory movements were abolished. In later publications Meltzer has described the method in detail, and has expressed the hope that intratracheal insufflation might prove to be of value for intrathoracic operations in the human being. A large number of experiments on dogs were made by Meltzer and Auer,² and many operations upon the intrathoracic viscera were performed by Carrel,² and by the writer. These showed conclusively that the method of intratracheal insufflation was a very efficient one for intrathoracic operations in animals.

The negative and positive pressure methods of Sauerbruch and of Brauer were first tested on animals, and because they were shown to make intrathoracic operations in animals possible through the avoidance of collapse of the lung, they were

* Read before the New York Surgical Society, May 11, 1910.

recommended in the human being. The method of intratracheal insufflation is so very simple, that if it should be proven to be as efficient in operations in man as it has been shown to be in animals, it would be a method of the greatest value in thoracic surgery in the human being.

In a previous paper³ the writer has considered in detail the advantages and disadvantages of intratracheal insufflation in man and has described an apparatus for use in the human being. At the time the paper referred to was written, we had not yet had any experiences in patients, and therefore the suggestion that the method of Meltzer should be tried in human surgery was based on the results of animal experiments and upon theoretical considerations. During the past few months we have used intratracheal insufflation in several patients, and the results have been very satisfactory.

From the experiences we have had I would suggest the following technic for the introduction of the intratracheal tube:

The tube that is to be introduced into the trachea should be a fairly rigid one of rubber with an opening at its lower end. It should be about as long as an ordinary stomach tube. Tubes of various sizes should be kept on hand. The tube to be used in a given case should fill up about one-half of the lumen of the trachea. One can obtain a sufficiently accurate idea of the size to be used by estimating the diameter of the trachea at the root of the neck.

The patient is first anæsthetized in the usual manner and the larynx and pharynx then thoroughly anæsthetized with 10 per cent. cocaine solution. In some patients the introduction of the tube can be accomplished by pulling forward the epiglottis with the index finger of the left hand, and introducing the tube into the rima glottidis with the right hand or with a laryngeal forceps. In the large majority of cases it may be preferable to expose the larynx with an appropriate speculum such as the Killian or Jackson instrument used in bronchoscopy, and then to introduce the tube with the larynx in full view.

When the sterilized tube has passed the vocal cords it is

pushed forward slowly until a slight resistance is felt—the bifurcation of the trachea. No resistance may be felt until the tube reaches the division of the right bronchus. If the tube is correctly placed, air can be heard to enter both lungs upon auscultation. The tube is then withdrawn about one inch so that its lower end will lie a short distance above the bifurcation. The sound of the air as it passes up and down the tube on expiration and inspiration is a proof that the tube has been properly introduced into the trachea. I have devised a special mouth-bit by means of which the tube is kept in place and against the upper teeth. The mouth can be freely opened so that the buccal cavity can be sponged out, a stomach tube introduced into the stomach if desired, etc.

The tube is now connected with the air-pressure apparatus, and air is blown through at a pressure of 10 mm. of mercury. After several minutes, the pressure is raised to 20 mm. and the operation can be begun.

When the pressure of the inflowing air and ether equals 20 mm. of mercury, inspiration and expiration will continue, air being inhaled and exhaled by the side of the tube. If there existed a profuse secretion of mucus in the pharynx and trachea, this will be found to have ceased soon after the insufflation was begun. Every two to three minutes, an assistant opens a vent so that the current of air which enters the tube is interrupted for a moment.

Two assistants are required to manage the apparatus and the anæsthesia,—one controls the pressure by the manometer and interrupts the stream every few minutes, the other manages the anæsthesia and watches the patient's general condition.

For a full description of the apparatus required, the reader is referred to a previous paper.⁴ The apparatus I have devised has been used by me for the intratracheal insufflation in the following cases:

On December 9, 1909, a young woman of thirty-four was admitted to the Mt. Sinai Hospital with advanced symptoms of myasthenia gravis. On the 25th, the patient stopped breathing for several minutes but respiratory movements returned again.

During the following night respiration suddenly ceased, the patient became deeply cyanosed, and asphyxia and death seemed imminent.

The insufflation apparatus had been kept in readiness at the patient's bedside. When I reached her she was unconscious, very deeply cyanosed, pulseless. Without trouble, the mouth was opened, the epiglottis drawn forward with the index finger of the left hand, and the tube passed through the glottis down into the trachea. A mixture of air and oxygen was then passed into the trachea under a pressure of 20 mm.

Within one minute, the appearance of the patient was completely changed; the face became pink, all cyanosis disappeared, the pulse could again be felt at the wrist. The pulse-rate was at first very slow—32 to the minute—but it soon became of good quality and more rapid—110 to 120.

For about five hours the intratracheal insufflation was continued and during this time the patient did not make a single respiratory movement. Her color, however, remained good, and her pulse of good quality. Finally the insufflation was stopped as the condition was a hopeless one.

This observation—which can be likened to the experiments in which curarized animals were kept alive for a number of hours—demonstrated the efficiency of the method for artificial respiration. Intratracheal insufflation should be of value in the treatment of asphyxia of many kinds—chloroform asphyxia, opium poisoning, asphyxia neonatorum, etc.

The following is the first case of an intrathoracic operation performed under anæsthesia by intratracheal insufflation:*

Abscess of the Lung; Thoracotomy and Aspiration of the Lung under Intratracheal Insufflation. Recovery.

B. F., a butcher, fifty-five years of age, was referred to the II Surgical Service by Dr. Manges with the diagnosis of an abscess of the middle lobe of the right lung.

February 14: The patient was anæsthetized with ether, and the attempt was made to introduce a small catheter into the trachea. The patient took the ether very badly, and I did not have on hand

* The full details of this case will be published by Dr. Lilienthal.

the proper kind of tube nor the necessary instruments for the intubation. After a number of unsuccessful attempts to pass a catheter through the larynx we determined to put off the intubation until a later time. The operator (Dr. Lilienthal) then resected four inches of the eighth and ninth ribs and packed the wound cavity with gauze.

February 20: Operation by Dr. Lilienthal, intratracheal insufflation by Dr. Elsberg. Ether anæsthesia; larynx and pharynx thoroughly anæsthetized with cocaine. A soft rubber tube, No. 28 French scale, was passed through the glottis by means of a laryngeal forceps and pushed downward until a slight resistance was encountered. The tube was then fixed to the upper teeth by means of a gag. The tube was connected with the insufflation apparatus and a mixture of air and ether blown in under a pressure of 15 mm. of mercury. The patient began to cough violently, therefore the intratracheal tube was withdrawn about one inch. The coughing ceased at once, and at the same time all evidences of mucus in the trachea or pharynx disappeared. The patient's color was good, respirations regular, pulse of good quality. The patient was now turned on the left side and the operation begun.

3.10—No cyanosis, pulse 120; incision 12 cm. in length into right pleural cavity; pulse unchanged, color good, no cough. Pressure of current now raised to 20 mm. Palpation of the lobes of the right lung.

3.20—Pulse 108; respirations 48; color good with slight cyanosis; pleural cavity is wide open.

3.25—Heart action excellent; pulse 96; color good, no cyanosis; aspiration of middle lobe of lung.

3.30—Pulse 105; respirations 42; color good.

3.35—Pulse 108; respirations regular, 40. The current of air is interrupted several times in order to observe the appearance of the lung. When the current is prevented from entering the intratracheal tube the lung collapses and is of a dark green mottled color; when the lung is markedly distended (25 mm. pressure) the lung is of a bluish color with areas of red. When the lung is collapsed the œsophagus and aorta can be seen and examined.

3.40—Suture of incision in pleura. While the last stitches are being passed the pressure is raised to 30 millimetres in order to slightly overdistend the lung so that as little air as possible shall remain in the pleural cavity.

3.45—Pleura closed with small drain; pulse 132 and of good quality.

3.50—Color good, no cyanosis; respirations 32.

3.55—Suture of muscles and skin; voluminous dressing. The intratracheal tube is withdrawn. Pulse now 120, of good quality; respirations regular, no cyanosis.

Four minutes after the patient was taken to his bed he was awake. He said that he did not have any pain in his larynx; he was not hoarse. The morning after the operation the patient was in very good condition. He complained of some pain in the right chest and had considerable mucopurulent expectoration. He was not hoarse and did not complain of any pain in his laryngeal region. The auscultation of the right side of the chest through the bandages was not satisfactory, but breathing sounds could be heard over the entire side.

From this time on the patient steadily improved, the cough and expectoration grew less daily; he was out of bed on March 10 and was discharged from the hospital with his wound almost healed on March 25. When last seen (April 22) he was in excellent condition; the breathing sounds over the right side of the chest seemed normal; he had almost no cough and practically no expectoration; he had gained considerable flesh and strength.

From the stand-point of the intratracheal insufflation, the operation was highly successful. The lung abscess could not be found at the operation. This was probably due to the fact that the patient had coughed up a large quantity of pus just before he was brought to the operating room. It is of exceeding interest, also, that almost all of the symptoms from which the patient had suffered for nine months, have disappeared. No good explanation for the gratifying result of the operation can be given. The resection of ribs, the pneumothorax, and possibly the insufflation itself might have contributed to this end.

The patient took the anæsthesia exceedingly well; only a small quantity of anæsthetic was required, and the contrast between the anæsthesia given in the ordinary manner and that given by intratracheal insufflation was very marked. As soon as the insufflation was begun, the patient who had been strug-

gling and coughing, his pharynx filled with mucus, became quiet, and the rattling of mucus in the trachea and pharynx disappeared. The patient recovered consciousness unusually quickly.

In order to test the method further, intratracheal insufflation anæsthesia was tried in the following case:

In a patient with an empyema of the right chest, a tube was passed into the larynx and trachea after the patient had been anæsthetized with ether and the larynx cocainized. Intratracheal insufflation anæsthesia was then begun with the apparatus and the operation—which consisted of resection of a rib and opening and drainage of the pleural cavity—was done without difficulty. The anæsthesia was very satisfactory; very little ether was required; the patient's color and his pulse remained good. There were no after effects from the insufflation.

The experiences we have had with intratracheal insufflation have demonstrated that the results obtained by Meltzer and Auer, by Carrel, and by myself, in our animal experiments, can also be obtained in the human being. A much larger experience is necessary before any definite statements can be made. There is every reason, however, for a thorough trial of the method. Meltzer's method of intratracheal insufflation recommends itself by its very great simplicity. If the future will show that it is as safe for the human being as it is for the animal—and our experiences seem to point in that direction—then surgery will have a very simple method for the prevention of the dangers from acute pneumothorax, a danger which has been the chief hindrance to the development of intrathoracic surgery.

REFERENCES.

- ¹ Jour. of Experimental Medicine, 1909, No. 4, see also 2.
- ² Medical Record, March 19, 1910.
- ³ Medical Record, March 19, 1910.
- ⁴ *Loc. cit.*

THE FIRST CASE OF THORACOTOMY IN A HUMAN
BEING UNDER ANÆSTHESIA BY INTRA-
TRACHEAL INSUFFLATION.*

BY HOWARD LILIENTHAL, M.D.,

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B.F., a butcher, 55 years old, had been under observation by Dr. Manges since September, 1909. At that time he gave a history of an illness of nine months, which began three weeks after he had cut and infected his finger while slaughtering a cow whose lungs and intestines, he said, were "studded with white granules the size of a barley-corn." The infection was severe and accompanied by a chill and fever. The finger was incised, following which the constitutional symptoms disappeared, and the wound healed slowly, taking three months before it was entirely closed. His illness dated, then, three weeks from the onset of this infection, at which time he noticed that his breath was foul, that he was continually nauseated, and that he was coughing a good deal. About a month later he had a severe chill followed by fever, and the same day coughed up about a quart of very foul, greenish pus. This relieved him for a time, although he continued to cough and to bring up quantities of pus, especially in the morning. A second febrile attack came on in September, 1909, when he coughed up a large quantity of blood. It was then that he was admitted to Dr. Manges's service at Mt. Sinai Hospital, where he remained three weeks and left much improved. The improvement was only temporary, however, for he was able to work only a month before he was again taken ill in the same manner. From that time his history was a repetition of the symptoms previously outlined, and the patient again applied to the hospital for relief. On February 10, 1910, he was again admitted, after Dr. Manges had referred him to me, this time to the Second Surgical Service.

* Read before the meeting of the New York Surgical Society, May 11, 1910.

His general nutrition and color were good. He was a thick-set, short-necked man, with a barrel-shaped chest, which showed fair and equal expansion on both sides. The percussion note was somewhat impaired over both lungs, with slight dulness in the right axilla and at the right base, posteriorly. The breathing at the right base was somewhat exaggerated. Soft râles were heard scattered over the entire right chest. Vocal resonance and fremitus were not impaired and were equal on both sides. There was marked clubbing of the fingers. Temperature was normal; pulse 80 to 90. The patient was expectorating foul, greenish pus. No tubercle bacilli could be found although the Von Pirquet reaction was positive in twelve hours.

An X-ray plate showed a shadow of moderate density in the outer portion of the right side of the chest, between the first and third ribs anteriorly. There was calcification of the cartilage of the first rib, and apparently some infiltration of the mediastinal glands.

A diagnosis of lung abscess had been made, and now the possibility of a radical cure of this patient was suggested by the excellent results obtained in the animal experiments with Elsberg's modification of the Meltzer-Auer apparatus. The first attempt to use this method was unsuccessful because of the failure to introduce the tube into the trachea. This failure was due to a short, thick neck and a very irritable larynx, which could not be made tolerant even by a large dose of morphine and both ether and chloroform by drop method. Fearing to prolong unduly the attempt to introduce the tube, the drop anæsthesia was continued, and a broad resection of the eighth and ninth ribs, in the posterior axillary line, rapidly made without opening the pleura. There were no untoward symptoms following this operation. A very slight postoperative rise in the temperature (99.8°) took place and lasted for two days. By February 21 I considered that the patient was in condition for a second venture.

At this time the preliminary anæsthesia was as trying and unpleasant as before, but an application of 10 per cent. cocaine to the larynx and pharynx made it possible, with some difficulty, to pass the tube. The details of the anæsthesia and workings of the apparatus belong to Dr. Elsberg. It is sufficient to note here that the patient was easily kept in narcosis with a small

amount of ether and that the respiration was unimpeded by mucus, although this had been troublesome during the preliminary anæsthesia. The breathing was regular and extremely deep, except when the lungs were fully distended, when there was a moment of apnœa. The patient's color remained good throughout the operation and the pulse of excellent quality, varying between 108 and 132.

As to the operation itself: The wound was cleansed with peroxide of hydrogen and irrigated with sterile water. The pleura was then opened under pressure of 15 mm. of mercury. It was at once seen that the lung was distended to about two-thirds of its capacity, mottled, and rosy pink in color. Complete pulmonary distention could be secured by raising the pressure to 25 mm. The lung was collapsed and distended several times so as to observe the working of the apparatus. The pleural cavity was then explored by hand and by sight, and some dense adhesions found immediately beneath the scapula. This region was thoroughly aspirated through the chest wall, the needle being also guided by a hand in the pleural cavity, but no pus could be found. The pressure was then raised to 30 mm. while the pleura and superficial wound were being closed. The pleura was quite friable on account of granulations resulting from the first operation, and closure by suture was difficult. A small drain was left in the superficial part of the wound, and gauze thoroughly wet with normal saline solution and covered with rubber dam and gutta-percha tissue was bandaged over it, so that in the event of a slight leakage there would be less liability to pneumothorax, saline solution being drawn in instead of air. The patient was then sent to the ward. Ten minutes later he had entirely recovered from his anæsthesia so that he held conversation with those about him. At no time was there any dyspnœa.

His recovery was quite uneventful, and much to my surprise and delight his expectoration ceased, perhaps because the comparatively large rib resection permitted the cavity to become obliterated. The temperature on February 22 reached 102.6°; it steadily declined to normal on February 28, and on March 20 he was discharged practically well. There was still a mucopurulent expectoration amounting to about 2 or 3 drachms a day instead of the copious flow which existed on his admission.

I consider that this case was a most severe test of the Meltzer method of anæsthesia, because of the foul and septic condition of the discharge from the pulmonary cavity. In spite of this there was no pneumonia and not even a bronchitis.

The most notable feature of the anæsthesia, as mentioned above, was the total disappearance of the noisy rattling respiration which existed during the administration of the ether by the usual method. The preliminary anæsthesia was supervised by Dr. A. R. Chamberlain and the insufflation anæsthesia was managed by Dr. Elsberg.

SOME OBSERVATIONS REGARDING THORACIC SURGERY ON HUMAN BEINGS.*

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IN order to further the evolution of thoracic surgery, it seems to me the duty of every operator in this field to publish in full his personal experiences, favorable or unfavorable. In this way observations made by one may inure to the benefit of another; mistakes recognized as such in the course of an operation may be avoided in future similar cases. In thus working together, piling one stone—rough or cut—on top of the other, we shall soon have a structure that will be a credit to its builders, let us hope. We may then be in a position to make the work done within the thorax compare favorably with our daily triumphs in abdominal surgery.

So far my own experience in thoracic surgery upon the human subject, with the aid of differential pressure apparatus, has been limited to the following cases:

For diseases of the pleura (acute empyema) 3

For diseases of the lungs (abscess) 3

For diseases of the œsophagus (cancer) 4

All these operations have been done with the positive differential pressure apparatus, as described and illustrated in a previous paper (*Jour. Am. Med. Assn.*, Dec. 11, 1909).

The universal differential pressure chamber, of which the positive one forms a part, also described in said article, requiring a special room on account of its dimensions (16 x 8 x 8 ft.), is still at the Rockefeller Institute, pending the completion of the new Thoracic Department now in course of construction at the German Hospital. This chamber permits of the application of negative or positive or combined pressure. With its help I shall try to ascertain whether the effects of

* Read before the American Surgical Association, May 3, 1910.

positive and negative pressure upon the sick human being are identical, and if not, wherein they differ. The machinery is arranged for triple reserves, in case of a break-down, but without unnecessary duplication of any of its parts. (Conf. *Jour. Am. Med. Assn.*, l. c., and *N. Y. Med. Rec.*, March 19, 1910.)

I. PLEURA.

Acute Empyema.—To the many methods of treatment hitherto employed for this trouble, the differential pressure method forms a comparatively recent addition. Further experience is needed to thoroughly establish the procedure. The ideal operative method of treatment for this affection would, of course, be incision and evacuation of the abscess, with or without resection of the rib; inflation of the lung until the pulmonary pleura is in close contact with the costal; application of an air-tight dressing.

Sauerbruch states that he has done this in a number of cases and that, at the first change of dressing about a week later, superficial granulation was all that was left, which then was allowed to heal under ordinary dressings.¹

Personally, it has not been my good fortune to obtain such favorable results, and I believe it will be but rarely possible in these cases to eliminate with certainty a partial pneumothorax at the time of the operation. It is difficult to fully distend the inflamed and infiltrated lung tissue; some space will nearly always remain between its surface and the thoracic wall, even under high differential pressure. But, despite these conditions, I believe the method well deserving of further trials. Of the three cases thus treated in April and May, 1909, I will here briefly relate the history of one:

Boy 4½ years;² sick for ten days. Inflammation of the two lobes of the left lung, also lower lobe on right side, pleuritic effusion filling entire left cavity. April 3, 1909, resection of fifth rib in axillary line; pus, with masses of coagulated fibrin-

¹ *Journal of the Am. Med. Assoc.*, 1908, li, 809.

² This was the first case operated on at the German Hospital under differential pressure.

ous substance thoroughly removed. Then head of patient placed into positive differential chamber and pressure gradually increased up to a maximum of 14 mm. Hg. (about 18½ cm. water). During this procedure the lung is carefully observed; it is seen that it rises up to within about 1½ inch of the thoracic wall, refusing to be distended further; with each inspiration it is drawn in again. On the whole, its expansion is rather unsatisfactory; color, dark bluish-red; pressure not raised higher, as consequences cannot be estimated. Dry aseptic mammoth dressing with gauze and cotton without drain or rubber covering of wound. Patient stood operation nicely; lips red when returned to bed.

April 5: Pulse 84; temperature normal; good condition.

April 9: Same good condition; little cough. First change of dressing under superficial general anæsthesia and differential pressure; narcosis started outside; patient then put in position; differential pressure of 12 mm. Hg; dressing removed; healthy granulations; lung just in front of wound, of much better color (pink); very little discharge even after pressure has been slowly increased to 16 mm.

April 12, ninth day after operation: Temperature suddenly rises to 104°; 6 P.M., second change of dressing under differential pressure; external wound presents a level, granulating surface. Dressing forceps gently pushed into thoracic cavity fails to give exit to pus. Now pressure gradually increased; when reaching 16 mm. there is a sudden gush of seropus, shooting high up, after which no further secretion can be brought out. Short cigarette drain. Temperature promptly drops and remains normal. From now on, the patient is daily placed into the apparatus for increasing periods of time, in order to have him breathe under pressure. Soon cigarette drain removed. Patient is discharged at end of fourth week, with wound firmly closed.

Comment.—Although it is not uncommon for children, when operated upon with open incision and drainage, to be discharged within three to four weeks, with the empyema cavity closed, the simplicity of the treatment in this case, as also the advantages of the breathing under differential pressure during the after-treatment, greatly impressed me.

In a second case that soon after presented itself, I again

employed this method. In this instance a rubber dam was placed over the incision, allowing the fluid to escape into the surrounding dressing but preventing the entrance of air. Here, too, drainage for a short time became necessary later on. Again rapid, satisfactory healing of cavity occurred.

The third case entered the hospital profoundly septic and could not be saved.

Kausch, who operated upon some such cases under negative pressure, gives expression to the firm conviction that after-treatment under differential pressure insures more speedy and certain healing of empyema than any other known method. He also recommends change of dressings under differential pressure in order to prevent collapse of the redistended lung and the tearing of fresh adhesions.

Although the reported cases treated by this method are but limited, the results are such as to certainly warrant its further trial.

II. LUNGS.

Three Cases; Lesions due to Bronchiectasis.

CASE I.—Incision and Drainage of Large Bronchiectatic Abscess.

Man, thirty-two years of age; pneumonia seven years ago; since then sick; cough with pus expectoration during last two years; sputum foul; copious.

April 23, 1908, under local anæsthesia, resection of rib; lung adherent to chest; aspirator encounters abscess about 2 in. below surface; is opened with Paquelin cautery; from this moment on no further expectoration; abscess discharges through wound; expectoration recurs when external opening becomes clogged; patient, who lives in the country, goes home.

April, 1909, he returns much improved in general condition; small, not discharging sinus in side; expectoration of several ounces of fetid pus every morning.

Operation (April 29, 1909).—Differential pressure ready for use with patient's head inside of the chamber. Resection of seventh and eighth ribs, involving fistula; tract of canal excised and cavity in lung, the size of a small apple, opened; into this empty two bronchi of larger size. It is decided to treat the

patient conservatively, at least for the present. Therefore, cauterization of bronchial lumina and inner abscess membrane; tamponade with iodoform gauze; positive pressure not turned on.

Comment.—Having the differential pressure ready for instant use, should it have become necessary to turn it on, was most reassuring.

Later History.—September, 1909, the patient was brought to the hospital in a somnolent condition. Diagnosis: brain abscess; claimed by relatives and taken home, where he died.

CASE II.—*Multiple bronchiectatic abscess; partial pneumectomy, right inferior lobe.*

Boy, six years of age; two years ago laryngeal diphtheria, requiring intubation *in extremis*; three weeks later, expectoration of pus sets in; loses weight rapidly; left empyema.

Operated upon June, 1908, by Dr. G. R. Pisek at the Post-Graduate Hospital; spasmodic cough continues day and night with abundant expectoration of foul-smelling pus four to six times in 24 hours; no tubercle bacilli found; enters German Hospital with high fever which slowly decreases but never reaches normal; ronchi over both lungs; X-ray examination points to bilateral infection of lower lobe.

Plan of operation: resection of ribs and pneumolysis on left side. May 12, 1909, under anesthol anæsthesia and Trendelenburg's posture, on specially designed new table (see below) resection of sixth and seventh ribs, seventh being the one formerly operated upon. Intercostal tissues ligated and excised; good exposure with pillow under opposite side; lower right lobe tightly adherent to costal pleura and diaphragm by old bands which are divided bluntly or with scissors; its color is reddish blue, also adjacent part, evidently belonging to right middle lobe, whereas upper lobe appears yellowish rosy in color, being normal; lower lobe brittle, tears on loosening in many places; on account of its evident disease and multiple unavoidable injury, extirpation is decided upon, the rest of the affected lung tissue then to be treated by pneumolysis; firm adhesions between upper portion and chest wall slowly divided and pushed off, again entering lung tissue; then main bronchus gradually exposed; double ligature and division of vessels is nicely accomplished; branches of pneumogastric nerve not recognized; tightly adherent lymphatic glands are annoying; isolated bron-

chus clamped and crushed with Doyen's intestinal crusher, as described in my former article (*Jour. Am. Med. Assn.*, Dec. 11, 1909); bronchus inverted; entire procedure can be neatly done, same as in the animal. When placing first top suture, narcotizer gives warning of weak pulse; palpated through thoracic wound, heart is found to beat slowly and irregularly; respiration very superficial; no cyanosis. Operation immediately stopped; intravenous infusion; no improvement; mass ligature quickly placed around bronchial stump and patient removed from apparatus. By this time heart had stopped beating; pupils dilated; all efforts at resuscitation futile. No postmortem allowed.

Comment.—1. Operation would have been feasible without differential pressure, but use of latter was most reassuring.

2. In view of multiple localization of trouble, the intended pneumolysis would have been preferable to attempted extirpation; the various rents in the lung tissue that occurred in the course of operation would in that case have had to be stitched up; this the boy would probably have stood nicely.

3. As there was no cough during anæsthesia and pus had been evacuated by coughing before starting operation, it is to be assumed that aspiration of pus did not occur, and such accident therefore was not, in part, responsible for the sudden change in the action of the heart during the operation. Still, Koerte's advice, to put these patients under superficial anæsthesia throughout the operation, in order to enable them to expectorate, had evidently better be strictly followed.

4. Isolation of bronchus, crushing and inversion of stump, in the human subject nicely feasible, same as in animals. The presence of tightly adherent glands at base of bronchus is annoying.

5. In this case heart seems principally to have been responsible for the death; attempt at explaining the giving out of the heart in the course of the operation, see below under *oesophagus*.

CASE III.—*Bronchiectatic abscess of lower lobe of left lung; partial pneumectomy.*

Boy, thirteen years of age; operated upon last summer for

lung abscess by Dr. Martin Rehling, adjunct attending surgeon to the German Hospital. The differential pressure apparatus not being on hand at that time and no adhesions present, immediate severe collapse on table after incision of pleural cavity; lung pulled forward, stitched to ribs; dressing; boy recuperates. Lung incised after 48 hours, drained for many months; wound then closed; coughs up a few ounces of fetid pus every day. Never tubercle bacilli. Re-entered hospital. Clinical examination and X-ray point to seat of trouble in lower left lobe alone.

Decision: Extirpation of lower left lobe. February 23, 1910, anesthol anæsthesia; patient is cyanotic before he is washed up; either too much anæsthetic or aspiration. Narcotizer claims boy coughed up some pus during beginning of anæsthesia, although the patient had tried to thoroughly empty cavities just before starting; oxygen added. Incision in seventh intercostal; 6 plus pressure all the time; again free pleural cavity entered. Lung adherent to chest wall only in immediate neighborhood of original incision; upper lobe feels soft and normal; lower more resistant; in the attempt to gradually loosen the lower lobe from its normal firm union with upper lobe, the latter is slightly torn; tampon; in order to form pedicle, temporary ligature (gauze-strip) of portion of superior lobe becomes necessary; clamp placed peripherically; division; now ligature of vessels as in animal experimentation,³ nicely feasible, but impossible to reach those at lower circumference of bronchus on account of the firm lung adhesions downwardly. At this time narcotizer, who, during the latter part of the operation had used only oxygen, reports pulse weaker. Operation hurried and lung loosened from chest wall, after silk ligature close to the latter; division between it and clamp; heart beats slowly; intravenous infusion, 800 c.c.; in course of latter last large vessel alongside bronchus is ligated doubly and divided; operation then interrupted; wet towel on top covers wound; patient recuperates nicely; still, hurry is needed; bronchus perfectly freed; after silk ligature has been placed proximally around same, narrowing its lumen (Friedrich), crushing centrally of distal clamp with improved Doyen, which allows of graduation in compression (see Fig. 2). Silk ligature around crushed portion; division between the same and clamp; large stump; Paquelinization; no inversion with top sutures, in order to save time; tampons,

³ Jour. Am. Med. Assoc., 1. c.

FIG. 1.



Inferior lobe of left lung obtained by pneumectomy for bronchiectatic abscesses; actual size of specimen, divided by section cut. The pronounced distention and contortion of almost the entire bronchial tubes is well marked.

FIG. 2.

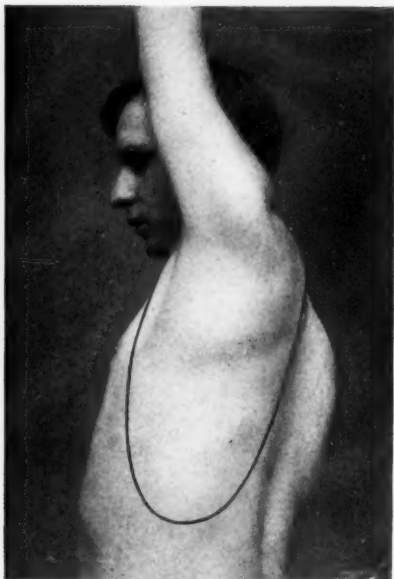


FIG. 3.

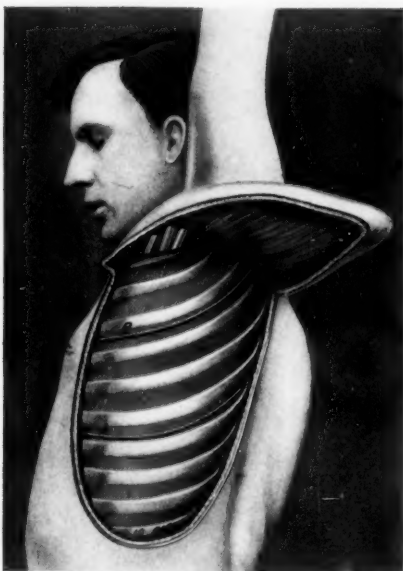
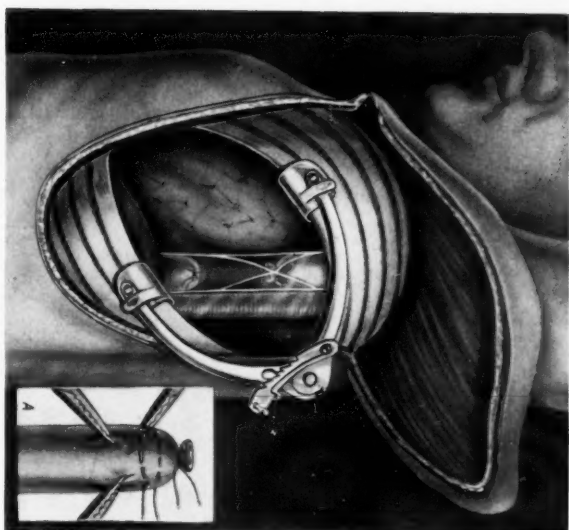


FIG. 2.—Schede's incision for raising a skin muscle flap, inclusive of the scapula. It begins at a point about 2 in. from the border of the sternum and $\frac{3}{4}$ in. below the clavicle, touches the tenth rib, and ends opposite, about 2 in. side-ways from the spinous process of the second or third dorsal vertebra. It is of advantage to have the skin muscle flap well overlap the intercostal incisions in order to insure air-tight occlusion of the thoracic cavity. Above, exposure of the first rib with the subclavian artery and vein and the brachial nerve plexus is not absolutely required, but the three upper ribs override easier when compressed by the rib-spreader, if all of these parts are thoroughly exposed.

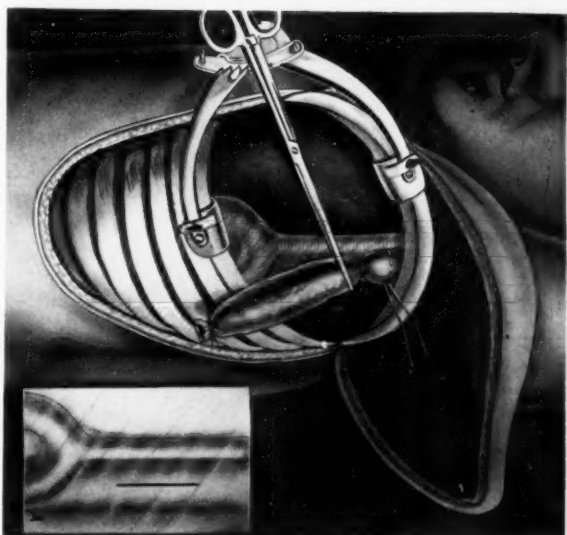
FIG. 3.—The flap raised. With the arm pulled up perpendicularly, the scapula takes a position at right angles with the thorax. When the patient's head is in the differential pressure apparatus, the arm forms a right angle with the thoracic wall. Then by turning the arm inwardly 180° (or the forearm 360°) the scapula moves away from the chest and can be well held out of the way. A, incision in sixth; B, incision in third intercostal space.

Fig. 4.



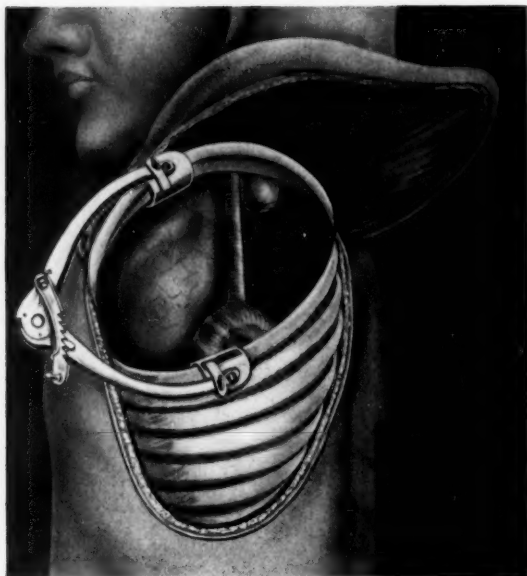
Incision in sixth intercostal space; rib-spreader in place; to the left, lung and diaphragm visible; to the right, the descending aorta still covered by the continuation of the costal pleura; next to it, the esophagus, divided; lower end inverted; the upper tied with silk. Pneumogastric nerves run on either side, with their anterior osculation. A, lower stump of the esophagus ready for inversion, with the purse-string suture in place. It is best to pull the tube apart with three clamps.

Fig. 5.



Incision in third interspace; rib-spreader turned around, as scapula is in the way; esophagus exposed by incision about 1 in. to the outside of the common carotid, which remains covered with pleura, as also does the aortic arch (4). The portion of the esophagus harboring the tumor, pulled from behind the aortic arch, tied and clamped, ready to be divided with Paquin cautery, completing the resection. The first of the two superior purse-string sutures in place, for inversion of upper stump.

FIG. 6.



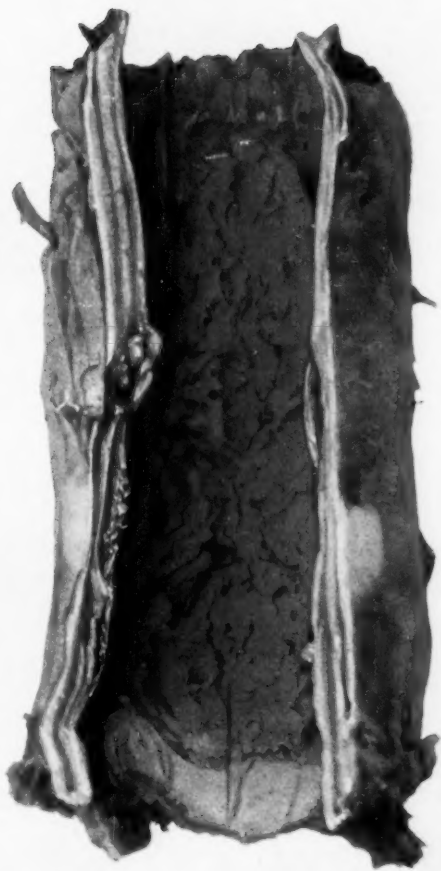
Interior of the cavity as it appears after completed double inversion of upper esophageal stump. Note below the latter the groove in which the esophagus rested.

FIG. 7.



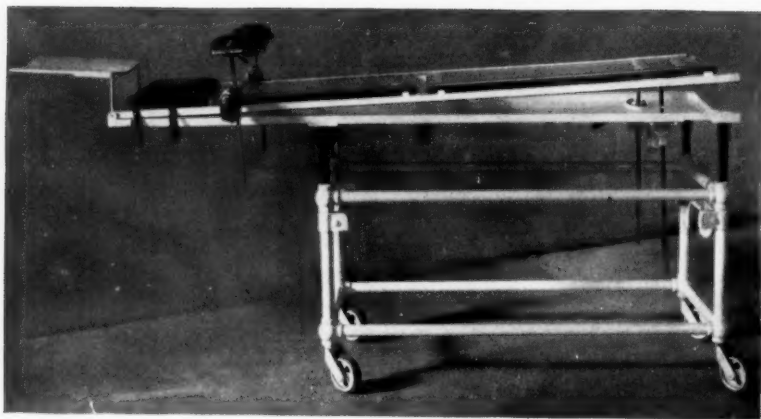
X-ray taken in oblique diameter with the patient's left arm raised up perpendicularly. Esophageal stricture made visible by bismuth paste, which has been swallowed just before the radiograph was taken; the lower end of the dark shade corresponds to the eighth intercostal space. To the left of this shadow (right side of patient), spinal column; to the right (left side of patient), heart and aortic arch. The figures "8" mark the eighth rib posteriorly and in front.

FIG. 8.



Resected portion of œsophagus; actual size of the specimen as it appears to-day. At either end the normal mucosa appears; the rest of the cylinder occupied by the infiltrating epithelioma. On left side of upper portion projects stump of the divided hypogastric nerve. The tumor occupied a distance from two inches above the cardia to a place underneath aortic arch.

FIG. 9.



Special operating table for thoracic work, in use at German Hospital. Note hinge for Trendelenburg's posture at extreme left. Head-rest removable. Attachment for bending of patient's thorax movable longitudinally. Table vertically adjustable.

FIG. 10.

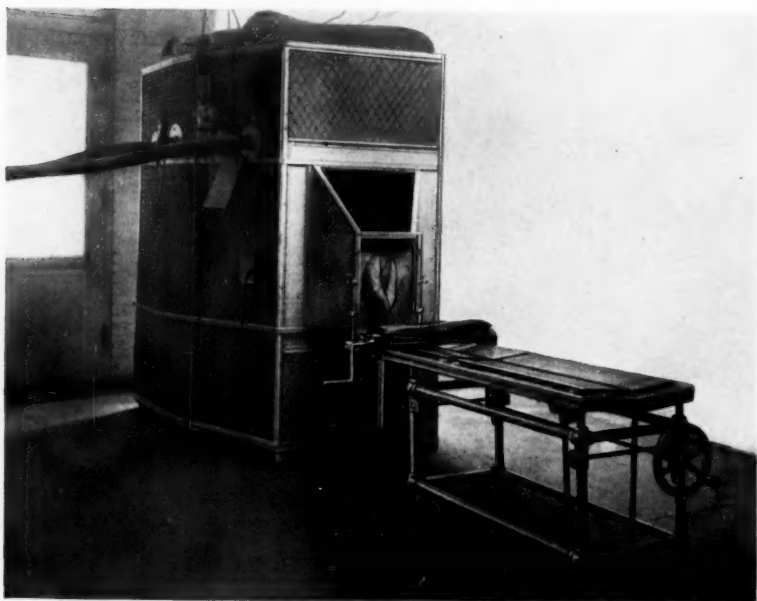
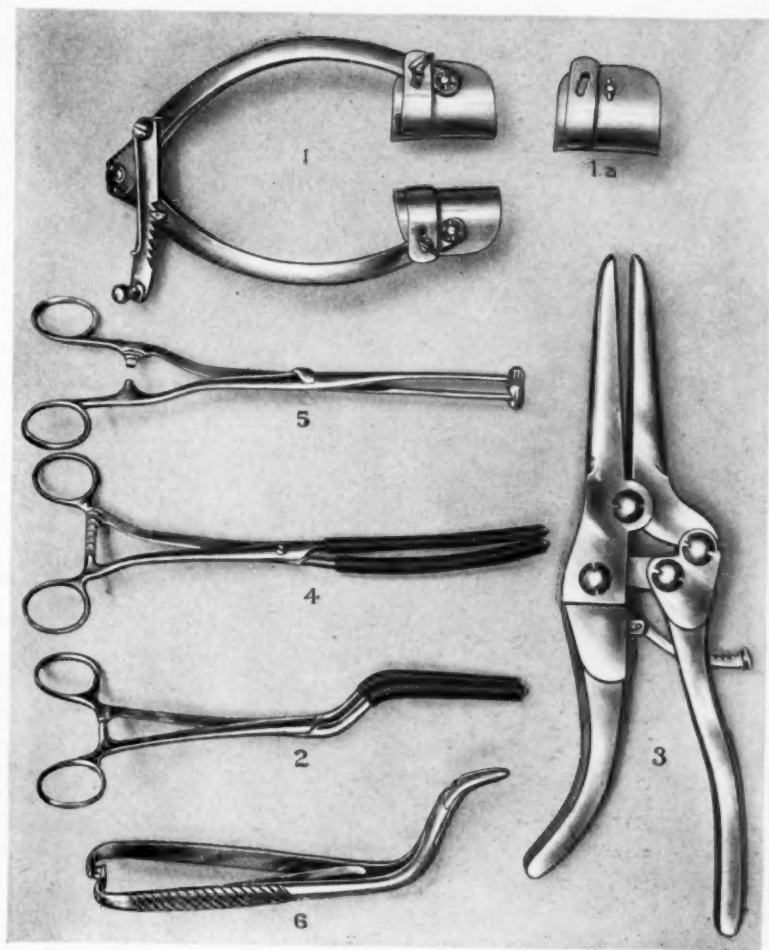


Table moved up to positive differential pressure cabinet; head-rest removed. Patient's head projects out over table and is adjusted in collar of cabinet without changing position of body.

FIG. 11



Instruments found useful in thoracic work: 1, Friedrich's rib-spreader; 1a, exchangeable larger blade; 2, bayonet clamp, branches ensheathed in rubber tubes; 3, improved Doyen crusher; 4, large curved intestinal clamp, again branches covered with rubber; 5, author's diaphragmatic forceps; 6, improved "Küster's swan" (needle-holder).

soaked in Lygol's solution, placed against stump, emerge at posterior angle of wound; layer sutures, thoroughly pressing tampons into angle; wound covered with rubber tissue to make cavity air tight as in empyema; mammoth dressing; patient's lips red; normal, regular respiration; 15 minutes later, in bed, pulse regular, well palpable at femoral, but weak at wrist (56); slows down still further in spite of stimulation; patient dies about one hour after operation, without regaining consciousness.

The specimen obtained is very interesting. The entire lobe harbors exceedingly distended and contorted bronchioles (Fig. 1). Postmortem not allowed.

Comment.—1. The fact that patient reached his bed with a pulse of 56, instead of the usual rapid pulse after prolonged operations, breathing remaining normal, points to vagus reflexes, probably due, in part, to ligation of a branch, when tying the main vessels. The branch of the pneumogastric nerve, running from its main trunk with the vessels on to the bronchus, could not be seen in this case; still, special efforts should have been made to single it out and divide it. F. Reich has shown that the division of a larger branch or branches of the pneumogastric is well borne, whereas blunt injury, as pulling, clamping, tying, often causes serious reflex symptoms. For this reason, it may be advisable in future similar cases to resect the lung, about 1–2 inches peripherically from the first division of the main bronchus instead of extirpating it with the help of inversion of the bronchial stump, although here, too, the smaller branches of the vagi accompanying the bronchial tubes would have to be ligated with the vessels.

Friedrich found the distal bronchial stumps insensible, but noted severe vagus reflexes on compressing or severing the proximal end of the bronchi, when pressing with a gauze mop against the mediastinum, and that more pronounced in the human being than in animals.

2. Technically, the operation went smoothly, the only disturbance being the narcotizer's warning.

3. It seems advisable in cases of this kind to primarily drain the lung abscess or abscesses externally, if necessary even for a second time, in order to guard against aspiration.

4. It seems further advisable to use superficial nitrous oxide-oxygen anaesthesia, instead of other narcotics for the more serious thoracic operations, in order to reduce to a minimum the unavoidable influence of the narcotic upon the heart.

5. The sudden shock seemed again to be due to vagus reflex. Discussion on possibility of avoiding same in thoracic operations, find below under "comment" on the case of resection of oesophagus.

The fatal issue in my two cases of partial pneumectomy, of course, was very depressing. However, both patients were bad risks; they had been sick for years, had expectorated foul pus for a long time, and were feverish and anaemic when they came under my care.

Criticizing the work, I would repeat that superficial anaesthesia, allowing the patient to expectorate all the time, seems to be a primary requisite in operations on younger patients; for older cases, local anaesthesia, plus a still more superficial general one, would probably be advisable.

Resection seems preferable to extirpation, provided the first division of the main bronchus is not involved in the disease, in which event, of course, extirpation has to be done.

In case typical extirpation is indicated, cocainization of the pneumogastric that runs perpendicularly downward through the thoracic cavity and crosses the main bronchus close to its base at right angles may be a recommendable procedure; it would inhibit the conductivity of the nerve during the operation. Such cocainization would have to be done as high up in the pleural cavity as possible. It would be an aid in overcoming the symptoms of immediate vagus reflex, but should not make the surgeon careless and make him forego search for and division of the nerve branch that runs with the vessels up to the hilus of the lung to be extirpated. Cocainization of both pneumogastrics in experimental surgery on animals has caused death, as was to be expected.

The question as to the best operative treatment of bronchiectasis is still an open one and, on account of the multilocular occurrence of the disease, certainly by no means a simple one. If one lung only is affected and the pulmonic

pleura not adherent to the costal pleura, the injection of nitrogen for bringing to contraction tuberculous lung cavities, as recommended by Forlanini, Murphy, and Brauer, has been tried with good result by Forlanini, Petersen, and Schmidt in the treatment of bronchiectatic lung abscess.

If both pleural portions have become adherent, pneumolysis might be done, but care should be exercised not to injure the lung tissue; and if tears do occur, they should be immediately closed air-tight by suture. Difficulty commences when a lobe harbors many smaller bronchiectatic abscesses and when a number of bronchioles communicate with the exposed cavity of a larger abscess.

For these cases Friedrich advises gradual breaking down of the dividing walls under very superficial anæsthesia, and exposing the parent bronchi, which, later on, have to be closed by suture, the operation to be done in a number of sittings.

Koerte advises resection of the lung for bronchiectatic affections. My own results of total unilateral pneumectomy in dogs (17 recoveries out of 21 operations) (*Jour. Am. Med. Assn., l.c.*) stimulated me to proceed likewise in the human subject.

In the interest of the advance of thoracic surgery in these cases, a more conservative attitude is advisable, explaining to the patient or his relatives that a number of operations at different sittings may be safer than radical work in one sitting, although the excellent result obtained in the latter way by Gluck may well tempt one to follow his example.

On the other hand, the excellent recovery of one of Kuettner's patients, with bronchiectatic abscess, in whom he opened the pleural cavity after multiple rib resections, liberated the adherent lung and allowed it to contract, should induce us to go rather slow and first try conservative methods of treatment in these cases.

III. ŒSOPHAGUS.

a. *Three Exploratory Thoracotomies.*

CASE I.—Man, thirty-seven years of age; obstruction found in lower portion of œsophagus, 32 cm. (12½ in.) behind teeth.

Operative Plan: Thoracotomy in eighth intercostal; if

tumor be found extirpable, typical excision with œsophagogastrostomy.

April 17, 1909: Anesthol anæsthesia; incision in eighth intercostal, 14 in.; plus pressure = 6 mm. Hg; no difference in breathing when opening cavity; lower lobe adherent to diaphragm and costal pleura, due to old pleurisy; loosened bluntly; many strong adhesions cut; then lobe pushed upward and forward; œsophagus exposed; lower end of infiltrating hard nodular tumor found to be 8 cm. (3 inches) above cardia; it extends several inches upward and passes underneath the arch of the aorta, with which it is, however, not closely connected; good exposure; attempt at radical operation appears inadvisable. Three silk pericostal retention sutures; soft tissues closed with three layer sutures of catgut; silk for skin.

Patient stood operation nicely. Following day, pulse and temperature normal; soon out of bed; first change of dressing on the seventh day; primary union except at two places, where thin pus is retained due to fascia necrosis. Slow healing of developing sinuses. Pericostal silk sutures must be removed. Such of absorbable material (chromicized gut) preferable, penetrating through silk hole in centre of lower rib, to avoid interference with nutrition by compression of the intercostal artery (Friedrich). Patient refuses further operating. He was presented before the N. Y. Surgical Society of April 28, 1909 (ANNALS OF SURGERY, 1, 642).

CASE II.—Man, sixty-three years old; pronounced chronic bronchitis. Œsophageal sound and X-rays place tumor about 1½–2 inches below aortic arch. In view of the oblique descent of the ribs in the human being (in contradistinction to their almost horizontal course in the dog) it appeared probable that the tumor could be reached through eighth intercostal; this access would have given a chance to attend properly to lower stump after the intended resection.

February 14, 1910: Intercostal incision, 40 cm. (15 in.) long, passing just beneath lower end of scapula; (pressure = plus 6 mm. Hg). No change in respiration after incision of pleural cavity. Many adhesions between lung and costal pleura divided between two ligatures or stripped off bluntly. Further up a hard irregular mass is palpated just below aortic arch corresponding to the place indicated by the X-rays. It is so high within the pleural cavity and so far away from the surface of the thorax, that, in spite of bending the patient's chest by

raising the cross-bar of the special operating table, the seat of the disease cannot be brought out in such a way that good surgery would be possible. An additional incision would have been required in about the third or fourth intercostal space, but here the scapula was in the way. In view of the patient's age, further work desisted from. Three silk retention sutures, drilling through lower rib and embracing upper one. Patient stood operation nicely. Two days later, out of bed.

February 20, first change of dressing. Wound puffed up in a few places; retention of pus, due to fascia necrosis; 2½ weeks later patient begins to lose weight. Therefore, March 12, typical gastrostomy (Kader). Again necrosis of fascia and split rectus muscle; leakage of gastric contents; fistula closed by double row of stitches. Stomach wound reopens; inanition; exitus, March 30. No autopsy.

CASE III.—Man, fifty-six years of age; localization of tumor behind aortic arch, at a point corresponding to second and third dorsal vertebræ, sound being caught about eight inches from teeth. X-rays corroborate this localization.

March 14, 1910: Curved skin incision surrounding scapular base with convexity downward, flap raised; curved circumcission of muscular attachment of scapula in its lower half; bone raised with sharp retractors; this gives access, under difficulty, to fourth intercostal; incision; no adhesions between lung and chest wall; in order to gain better access, skin muscle incision to a point beneath left mammary line has to be added. Resistance felt right underneath aortic arch. The field of operation again lies too far upward for proper asepsis, especially as scapula is not sufficiently out of the way. Therefore, closure of wound as in former case.

Patient stood operation well. Pulse at close 96, but weak; had had no hypodermic or other stimulant during operation. Intravenous of 800 c.c. after reaching bed. March 16, doing nicely; soon out of bed; later developed empyema which required drainage.

Comment.—When operating for œsophageal strictures situated thus high up, it is absolutely necessary to get the scapula well out of the way.

The experience gained in these three exploratory operations led up to a resection of the œsophagus, in which Schede's method of getting the scapula out of the way was employed. I

tried it first on cadavers; also tried such exploratory incisions as enable one to do proper surgical work at the upper as well as lower end of the tumor that involves the œsophagus. The work on the cadaver I was permitted to do at the morgue, through the courtesy of Dr. F. W. Schultze, general medical inspector under the Commissioner of Public Charities of the City of New York.

It was found that with the Schede incision⁴ down to the tenth rib, raising a large skin muscle flap along with the scapula, and twisting the forearm for 360° inwardly or the arm 180°, the raised scapula takes a position at right angles with the chest, exposing fully the upper nine ribs. (This, however, seems to be the case in frozen cadaver only.) In the one experience I had with the living, as described further down, the scapula did turn up so as to form a right angle with the chest, but did not stay up and had to be held in position. On dividing the third intercostal space down to the border of the sternum, with the help of double ligation and division of the internal mammary plexus, it was found that the upper three ribs could be made to act as a door does on hinges, the rib-spreader having pushed the third over the second and the second over the first (Figs. 5 and 6); the aortic arch and upper part of œsophagus can now be well reached. In order to do good surgery also as regards the lower stump, a second incision in the sixth or seventh intercostal is advisable. The latter should, of course, be done first, if the œsophageal bougie had located the stricture in the lower portion of the œsophagus.

Investigations on a cadaver made at a former occasion at the German Hospital, through the courtesy of Dr. W. G. MacCallum, the pathologist of the institution, had shown that the comparatively small human stomach cannot be pulled up further than 3-4 inches above the diaphragm, for the reason that in the human being the duodenum is attached and not entirely free within the abdominal cavity, as in the dog. Œsophago-gastrostomy, the ideal operation for the removal of an œsopha-

⁴Schede devised this incision in conjunction with the removal of the entire chest wall for the cure of patients afflicted with chronic emphysema of long standing.

geal neoplasm, can therefore be done only for resection of a tumor situated in the lower portion of the œsophagus. For tumors in the middle or upper portion of the œsophagus, excision of the growth with double inversion (purse-string suture) and gastrostomy will be the operation of choice. Experimental work done on dogs has proved to me that this is nicely feasible; the dogs live and thrive. Exit of the proximal stump through an intercostal space—as is claimed by some to be imperative—I do not consider necessary. Of course, patients ought to be asked first whether they are satisfied to take their food through a gastric fistula for the remainder of their lives. Some may not want to do this but prefer to die, although they may have the taste of what they eat and drink by first chewing their food. The masticated material is then blown through a long rubber tube, connected with the rather large rubber drain worn in the gastric fistula into the stomach directly (Trendelenburg), or it is spit into some broth or other kind of fluid and poured into the stomach. Chewing stimulates the stomach secretion; the saliva is thus also made use of.

In order to improve the functional result also for these patients, ways will have to be found to unite later on the proximal œsophageal stump with the gastro-intestinal tract in some manner. Such operations have already been done by several surgeons. Gluck and Perthes have successfully connected an œsophageal opening at the neck with the gastric fistula by means of an antethoracic prothesis. Roux, Kocher, Tuffier, and Kuemmel have made that connection subcutaneously, using a coil of the small intestine.

b. Resection of Œsophagus for Carcinoma.

CASE IV.—F. L., male, aged forty-three years (referred to me by Dr. G. H. Joslin of Hamden, Conn.), had been sick for six months; increasing difficulty in swallowing. X-ray photograph (Fig. 7) and œsophageal sound placed stricture 32 cm. ($12\frac{1}{2}$ in.) behind teeth, or about 8 cm. (3 in.) above cardia. After sounding with bougie à boule No. 40, swallowing much easier, and patient gained 8 pounds in first week, 2 pounds in second.

Operation (March 31, 1910).—Under nitrous oxide-oxygen

anæsthesia (Dr. R. C. Coburn), outside of pressure apparatus, curved incision down to tenth rib (Fig. 2), dividing borders of pectoralis major and latissimus dorsi muscles sufficiently, after which scapula can be well turned up with the large skin muscle flap. By means of the above described twist of the arm it is brought into a position away from the chest (Fig. 3), where it is surrounded with sterile gauze and bandage; ligation of divided vessels. Thereupon patient's head is placed in pressure chamber. Incision in sixth intercostal space (Fig. 3A), about 10 in. (25 cm.) forward from angle of ribs; pressure = plus 6 mm. Hg.; rib-spreader put in place (Fig. 4); lower lobe of lung has many adhesions to costal pleura and diaphragm, which are partially divided between two ligatures, partially broken up bluntly. Palpation shows tumor in lower end of œsophagus, about one inch away from cardia; infiltration reaches upward to a place underneath aortic arch; division of pleura; œsophagus gradually loosened from its bed and encircled by finger above cardia. Pulse at this time not quite as strong as before. Hypodermoclysis (1500 c.c.) given in thigh. Careful stripping off of nervi vagi, above cardia; on palpating infiltrated œsophagus further up, it seems to be possible to resect it. After laying of purse-string suture (Fig. 4A⁵), primary division of distal end between two silk ligatures with Paquelin. Upon loosening lower part of œsophagus, it seems that cardia could be easily pulled into thoracic cavity. Typical inversion (Fig. 4); five silk top sutures.

Second incision in third intercostal space (Fig. 3B); in order to avoid preparing of mammary gland forward, incision is carried to a place underneath the external border of the breast and then lengthened sufficiently backward to the angle of the rib, so that, with rib-spreader in place, the area above aortic arch can be nicely reached⁶ (Fig. 5); pleura divided to the outside of common carotid (Fig. 5A); œsophagus immediately reached; loosened,

⁵ Special care is required not to penetrate into the lumen of the œsophagus when placing the purse-string suture. The muscular coat of the human œsophagus is much thinner than that of the dog.

⁶ It is interesting to note how the rib-spreader pushes the third rib over the second, and this one again over the first (Figs. 5 and 6), although the intercostal incision is not carried to the border of the sternum with ligation and division of the internal mammary plexus, as this was first observed on the cadaver. The three ribs thus pushed over one another, the rib-spreader turns them as a unit around the longitudinal axis of about the second rib, making them act as a swinging door does upon its hinges.

encircled by finger and followed down from above behind aortic arch; with fingers of right hand introduced from below through the incision in sixth intercostal space, the mass is loosened all around. To pull up the mass now, from beneath the aortic arch is found impossible. Cause: the nervus vagus is a unit with it further up. On trying to prepare it off, the tumor mass is entered, but œsophageal cavity not opened. Hence, of dire necessity, the right vagus, viz., the one running on the medial side of the œsophagus, is divided, and now the tumor pushed and pulled from underneath aortic arch, so that it appears above (Fig. 5). It cannot be entirely freed and it is discovered that the nervus vagus on the right side of the œsophagus enters the mass also from above. There is no possibility of stripping it off and, inasmuch as lower divided end of œsophagus cannot be inverted into the tumor mass, operation cannot be broken off, but has to be gone on with. Division of nerve; purse-string suture; amputation of tumor in healthy tissue; double inversion of œsophagus, which is nicely feasible, the stump appearing in the uppermost vault of the thorax, just where the œsophagus enters the pleural cavity (Fig. 6). When bluntly handling the nervi vagi at the lower end of the œsophagus and again after dividing the pneumogastric nerve above the tumor, narcotizer as well as assistant who holds the arm of the patient, report greatly deteriorated heart action. Closure of intercostal incisions with chromicized gut, drilling through lower rib; tying same after the two ribs had been temporarily held in place by two pericostal silk sutures which are afterwards pulled out; skin muscle flap with scapula turned down; the divided serratus fibres are stitched together, as well as those of the pectoralis major and latissimus dorsi; second continuous suture of fascia on top; careful skin suture, working from both sides; dressing. The patient is taken out of apparatus with lips red, pure oxygen having been administered during last $1\frac{1}{2}$ hours; as soon as the head is removed from the apparatus, his hitherto red lips turned a deep blue. The jaw was pushed forward, the tongue pulled out, and oxygen again administered. Subcutaneous stimulation and intravenous infusion. During the latter the patient expired, about ten minutes after completion of the dressings.

Pathologic examination of the tumor (see Fig. 8) by Dr. MacCallum proved it to be an epithelioma.

Comment.—1. Technically, the operation is nicely feasible. The formation of Schede's flap in order to get the scapula

thoroughly out of the way seems to be a recommendable preliminary routine procedure for the resection of malignant strictures of the œsophagus. It permits of entering the thoracic cavity, wherever it is required; it enables the surgeon to properly reach and master the deep-seated operating field, and maintain asepsis; it meets every emergency. The multiple intercostal incisions do not increase in any way the seriousness of the operation.

Regarding the entrance into the thoracic cavity, intercostal incisions seem preferable to resection of ribs, although the rib-spreader, when opened, frequently fractures a rib in human beings. The steep, oblique descent of the ribs in the human subject and the extreme narrowness of the interspaces are responsible for this accident. It is expected that such fracture will be avoided by curving the patient's thorax over a pillow, or by raising the cross-bar attachment to the special operating table (Fig. 9), which latter is the result of the joint efforts of myself, my brother, and the Kny-Scheerer Co., who built the table for me.

2. In doing this operation, it is necessary to expose the nervus vagus above and below on either side of the affected portion of the œsophagus. This is to be the *very first step* after having gained entrance to the thoracic cavity and having pushed the lung aside. If both pneumogastrics have become involved, the operation should be broken off; if one only is found to be invaded by and inseparably connected with the tumor, it may be cut. Further physiologic experimental work will be welcome to show the surgeon whether and where he may safely cut one of the pneumogastrics within the thorax, and also if there be any difference, whether the one to the right or the one to the left of the œsophagus be divided.

3. The only hope of helping patients with œsophageal carcinoma lies in *early operation*. Exploratory thoracotomy should be done as soon as the first signs pointing to a malignant stricture appear. Not infrequently it will be possible to corroborate the diagnosis even then by the X-rays (bismuth paste), œsophagoscopy, and microscopical examination of a small particle of the growth extracted on that occasion.

It *should be* remembered that the diagnosis of carcinoma

of the œsophagus is not difficult, that the tumor is clinically the most benign of all carcinomas from the mouth to the rectum. Yet it should also be borne in mind that every patient, not operated upon, is absolutely lost, within an average of fifteen months.

At present, the mortality of resection of the œsophagus is still 100 per cent.

It is to be hoped that the feasibility of successful operation in these cases will soon be demonstrated, so that patients may be induced to submit to early operation.

A review of the literature shows that carcinoma of the œsophagus has been the cause of intrathoracic operations not less than 34 times. The exact number of cases cannot be stated, because full reports of the last Surgical Congress at Berlin, April, 1910, have not yet reached us.

As nearly as I could make out, resection of the œsophagus in the human being has been reported 21 times, by seven European surgeons, viz.: Mikulicz, 3; Sauerbruch, 4; Tuffier, 1; Küttner, 6; Wendel, 5; Tiegel, 1; Kümmel, 1. Œsophagogastrostomy, with the button, leaving the tumor in place, 1 (Sauerbruch). Thoracotomy was done 6 times with the intention of resecting the œsophageal neoplasm; local conditions, however, forbade radical work, the thoracotomy thus remaining an exploratory one. To these operations are to be added my 4 cases described above, *i.e.*, 3 exploratory thoracotomies and 1 resection for œsophageal cancer, making a total of 21 resections; 1 palliative operation and 9 exploratory thoracotomies. Sauerbruch mentions 7 further cases of his own, without giving details as to whether resection or exploratory operation only was done. Total number of operations, 39.

Of the cases in which exploratory thoracotomy was done, all recovered. The œsophagogastrostomy case (button) died. Of the resected cases none recovered.

I have tried to analyze the causes of the fatal issue in my own case of resection of the œsophagus.

As in other major operations, death in these cases may be due to (1) general anæsthesia, (2) hemorrhage, (3) lack of asepsis, (4) shock.

1. General anæsthesia, in my case, was in the hands of an expert; nitrous oxide plus oxygen was used, the least detrimental of all narcotics so far known; during the last one and one-half hours of the operation pure oxygen was administered. The deleterious effect of the anæsthetic, as such, can therefore be excluded.

2. Hemorrhage: There was no hemorrhage whatever; a slight arterial oozing, when loosening the lower portion of the infiltrated œsophagus from its bed, could be nicely controlled by temporary compression with a gauze tampon.

3. Faulty asepsis: No mistake occurred; besides the effect of any such neglect could not have been immediate.

4. Shock is the only possible cause remaining.

I believe that the so-called shock in these operations is of twofold origin:

a. Interference through blunt manipulation with the system of the pneumogastric nerves and their manifold anastomoses with the sympathetic plexuses.

b. Accumulation in the blood of carbon dioxide, no matter in what manner differential pressure be applied.

Both these factors induce the so-called "vagus pulse." Verworn succeeded as early as 1892 in asphyxiating an animal by CO_2 retention while it was breathing pure oxygen. The true inwardness of this surprising fact was brought out later by Volhard's instructive paper. He was endeavoring to find out whether curarized dogs could be kept alive by continuous gentle insufflation of pure oxygen through a narrow rubber tube into the trachea, with free escape of the oxygen around the tube to open air. The thorax was left closed. Animals were kept alive in this way for from 1 to 2 hours; they finally died of CO_2 retention. He found that oxygen was drawn into the alveoli by a suction corresponding to 15 mm. Hg negative pressure. If only this want was supplied, the animals would die in about ten minutes. But by a more rapid flow of the oxygen the CO_2 retention was diminished and the animals would remain alive an hour or more. The use of air in place of oxygen resulted in rapid death of the animals of CO_2 retention, because only one-fifth of the air is oxygen, so that after its absorption there remains space for each subse-

quent tidal inflow of only one-fifth of the preceding one. Volhard did not increase the pressure in the lung.

In differential-pressure operations CO_2 retention also seems to occur. Sauerbruch and Küttner state that in case of weakness of the heart in the course of an intrathoracic operation, sudden increases of pressure have been found a most effective help. Petersen found lung gymnastics a heart stimulant. Volhard's experiments explain the cause of this observation. The so-called shock in these cases is evidently partly due to an accumulation of carbon dioxide in the blood. In an exploratory thoracotomy of short duration such retention of the noxious gas is not sufficient to do injury. But in the longer operations, for instance the resection of the œsophagus, the greater CO_2 accumulation and the added effect of the necessary blunt handling of the network of the pneumogastrics, both acting cumulatively in the same direction, is too great a strain upon the heart, and it gives out. This has been my observation also in the two cases of partial pneumectomy, above cited. When ligating the many vessels along the bronchus, undoubtedly one or more branches of the pneumogastric of the lobe of the lung became included in the ligature. Everything having gone fairly well up to that moment, a sudden turn occurred; the heart, already weakened by the slowly increasing cumulative action of the carbon dioxide, received its death-blow through the added nerve reflexes.

A very important conclusion can be drawn from these experiences. It is necessary in the course of thoracic operations of long duration to interrupt now and then the pressure, allowing the lungs to collapse; in other words, to interpose at regular intervals brief periods of artificial respiration by means of the apparatus, in order to clear the system of its CO_2 accumulation. It will be best to do that *before* any alteration of the pulse has been noted by the narcotizer or by the assistant on the outside of the apparatus, detailed to watch the pulse at the wrist or at the foot.

It is not quite correct to call this procedure artificial respiration, because the patient keeps on breathing spontaneously.

Slow rhythmic changes of pressure are made and the patient is merely forced to breathe from varying levels of pressure. At the same time the open side of the lung rises and falls with the pressure.

To avoid weakness of the heart, the surgeon should further do his utmost to handle the pneumogastrics as gently as possible, also cocainize one of the two nerves. A hypodermic of $\frac{1}{60}$ grain of atropine before, and, without fail, about one hour after the beginning of the operation; further, an intravenous infusion with 10-20 minims of adrenalin will be found helpful aids.* In cases of emergency direct massage of the heart, the operator taking hold of the organ with his hand, may be of great assistance.

After the completion of the intrathoracic work, if the pulse remains weak, it will be unwise to close the chest and then remove the patient from the pressure chamber, leaving him to his own resources at a moment when he should receive the utmost assistance. Rather should rhythmic pressure by means of the apparatus be continued with the thorax open, until the heart has recuperated.

What can be done for the heart in that way I had brought home to me in recent experiments on curarized dogs. Using my positive differential pressure apparatus, a curarized narcotized dog was kept alive by means of artificial respiration, performed with that apparatus, for upward of one hour and,

*On May 31, I had occasion to test the suggestions made above, in a greatly reduced female patient with cardiospasm of 16 years' standing, necessitating gastrotomy. Sounds could not be made to pass the cardia; there was a large œsophageal pouch above the diaphragm. Thoracotomy proved the diagnosis to be correct. A double "œsophagopli-catio" was done, in order to reduce the diameter of the pouch, and the thorax closed. Rhythmic pressure was applied for several minutes at intervals of $\frac{1}{4}$ hour during the course of the operation; toward the end, it was applied continuously. An intravenous infusion of saline with adrenalin was also given. Patient stood the operation nicely. At present, three weeks later, the patient is again able to swallow solids without any regurgitation, and feeding through the gastric fistula is no longer necessary. She is gaining flesh steadily. An exploratory thoracotomy for a tightly stricturing epithelioma of the œsophagus, done on June 29, was rendered by means of these brief rhythmic pressure changes at regular intervals as smooth and satisfactory as any of our daily operations in other parts of the body.

time permitting, could have been kept alive indefinitely. The differential pressure was then turned off for four minutes, so that the dog was under acute pneumothorax during all that time, and, with subsequent artificial respiration by means of the apparatus, the heart was promptly restored to proper action.

In the second experiment, artificial respiration was made while operating under negative pressure, the valve of the large negative chamber being opened and closed in the same way as that of the positive chamber in the first experiment. The curarized narcotized dog was subjected to double pneumothorax for three minutes. At the end of the first minute the heart became very weak; it stopped beating altogether within a little less than $1\frac{1}{2}$ minutes. I waited another $1\frac{1}{2}$ minutes; then began artificial respiration with my apparatus at the rate of two complete respirations per minute and, after a very little while, the heart beat again 120 per minute with a full pulse. It seemed to be of benefit for the restoration of the heart's action to run up the pressure higher than required for ordinary differential pressure purposes, viz., 10 mm. Hg. Under this pressure every part of the lung became fully inflated and pink.

In both experiments the glottis became obstructed by the collapse under curare of the paralyzed laryngeal muscles. A short rubber tube was quickly introduced into the glottis to hold it open, and, with it in position, the animals were revived as described above.

In operations on human beings, when making rhythmic pressure, the surgeon can tell by the action of the lungs whether the glottis is open. The lung rises and falls with the changes in pressure. If this does not occur, although the epiglottis has been properly raised, closure of the glottis must be the cause. Experience will show whether in thoracic operations on human beings closure of the glottis is an occurrence that has to be reckoned with. In that event, the narcotizer should be provided with an O'Dwyer tube.⁷ So far, no mention of this subject has been made in the literature.

⁷ This is another reason for having two men inside of the positive differential pressure apparatus for the conducting of the anaesthesia.

Rhythmic pressure at the end of the thoracic work and before closing the thorax is advisable for still another reason: the tampons that had to be placed for maintaining asepsis compress the lung on the opened side; in this way a kind of pneumothorax is produced that might be called "mechanical pneumothorax," the other lung meanwhile doing most of the work. To some extent the bad features of acute pneumothorax must make themselves felt, principally the bulging of the mediastinum towards the closed side. The resulting CO_2 accumulation is eliminated by the rhythmic pressure.

In conclusion I would say that the road into the thoracic field is rough and stony, strewn with many depressing disappointments. Still, the work is so fascinating and there are also so many inspiring experiences that I have no doubt thoracic surgery will soon become a favorite branch of our science and form an integral part of the routine work of our hospitals.

IV. APPARATUS.

Thoracic surgery should be done at the hospital, not only for the sake of asepsis, but also on account of the strong artificial light needed for the work in the depth of the thorax. Only in such emergency cases in which the removal of the patient to the hospital would clearly jeopardize his life should intrathoracic work be done at his home; electric reflectors would then have to be carried along.

Hospitals will do well to secure one of the available differential pressure chambers or cabinets. They simplify the work, are always ready for use, meet every emergency, can be easily called into action in the course of an operation, can be used for after-treatment without inconveniencing the patient and without employing general anæsthesia.

While the differential pressure apparatuses may, at the first glance, appear complicated to the uninitiated, and are certainly rather expensive, they are in reality simple to manipulate. The manner of their construction and the reserves in the machinery of the apparatus of improved type, make intrathoracic work as safe as intra-abdominal work; they make the surgeon forget that he is working within the thorax. From

my point of view no apparatus is too good or too expensive for hospital use, if it has corresponding advantages.

The installation of a differential pressure chamber or cabinet at hospitals need, of course, not exclude the use of other differential pressure methods with their necessary apparatus.

V. OPERATING TABLES AND INSTRUMENTS.

It has been found desirable, when employing the apparatus I myself use, to have a special operating table which permits of moving the patient vertically and placing him at any time in Trendelenburg's posture. Figs. 9 and 10 show this table now in use at the German Hospital; the hinge, as will be seen, is at the place of the patient's neck.

When operating with the help of the large skin muscle flap, required in all operations in the upper part of the thorax, where the scapula will be found in the way, a table is preferable which permits of turning the patient also around his longitudinal axis. This type of table is now in course of construction.

Regarding instruments, Friedrich's rib-spreader (Fig. 11, 1 and 1a) has been found sufficient in the majority of cases. When resecting the œsophagus we have tried to get along with the instruments used in abdominal surgery. A bayonet clamp (Fig. 11, 2) and the improved Doyen crusher⁸ (Fig. 11, 3) are indispensable when doing pneumectomy. The large, curved intestinal clamps, their branches ensheathed in rubber tubes, are useful in resections of the lung (Fig. 11, 4). For handling the diaphragm, I have had special forceps constructed, which allow one to grasp the diaphragmatic muscular fibres, including the phrenic peritoneal cover, at right angles to the former, thus preventing a tear. They have been found useful in animal experimentation, when suturing the border of the rent, bluntly made through the diaphragm alongside the cardia, to the stomach, which had been pulled into the thorax for anastomosis with the resected œsophagus (Fig. 11, 5). The improved "Kuester's swan"⁹ (Fig. 11, 6) is *the* needle holder for placing deep sutures.

⁸ Made for me by Klöpfer of Bern.

⁹ New York Medical Record, 1905, lxviii, 569.

ARTIFICIAL RESPIRATION AND INTRATHORACIC ŒSOPHAGEAL SURGERY.

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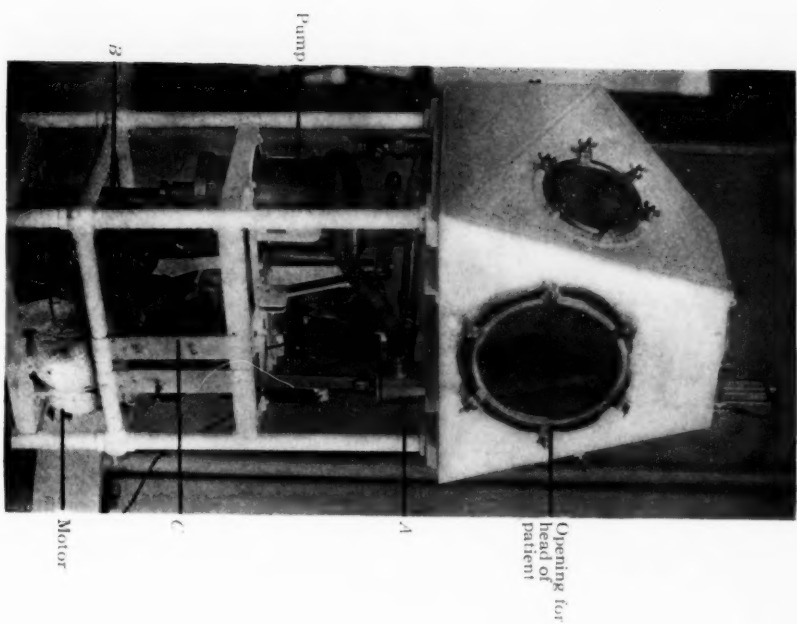
At the 1909 meeting of the American Medical Association we presented a paper on intrathoracic experimental surgery,¹ and we then described a new apparatus for performing operations under positive pressure and also a button for facilitating intrathoracic œsophageal anastomoses. Both the cabinet and button have been improved since that time, and our added experience with these warrants a more detailed description of each.

One of the new features in the cabinet has been the outgrowth of the previous work of one of us (N.W.G.).² In working with the intralaryngeal canula it was noticed that the alternating increase and decrease in intratracheal pressure produced an artificial apnœa which largely eliminated the movements of the diaphragm. The advantages of such an elimination of movement during operation were so apparent that it induced the other of us (H. H. J.), whose previous work had been done entirely with the negative and positive pressure cabinets,³ to devise another cabinet provided with a mechanism which accomplished during operation a similar cessation of respiratory movements.¹

Figs. 1 and 2 illustrate the improved cabinet which we wish herein to describe.*

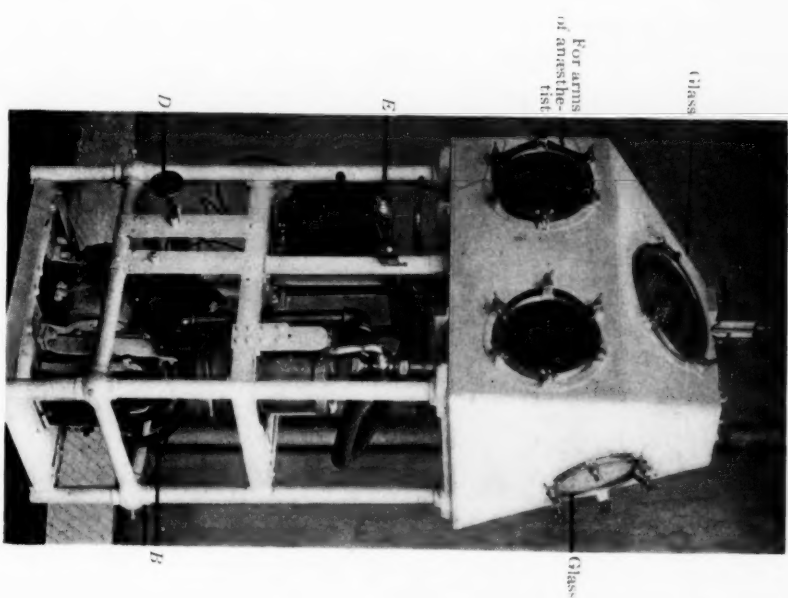
* The cabinet has been made for us by Charles E. Dressler, of New York.

FIG. 1.



Front view.

FIG. 2.



Back view.

FIG. 3.



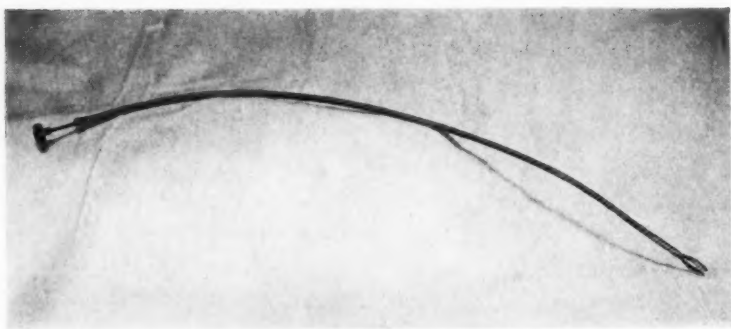
Button for lateral anastomosis.

FIG. 4.



Button for end-to-side anastomosis.

FIG. 5.



Holder for introducing button in lateral anastomosis.

FIG. 6.



Forceps for holding button in end-to-side anastomosis.

The important features of this cabinet are: first, its compactness and hence its greater portability than the larger negative or positive chambers; second, the inclusion of both the pump and motor in the space beneath the box; third, the ease and rapidity with which the patient's head can be introduced; and, fourth, the addition of the valve mechanism (*A*) permitting of a rhythmical rise and fall of pressure within the cabinet. This valve is so controlled by change speed gears (*B*) and a cone-shaped cam (*C*) that, not only a wide range in frequency of artificial respirations can be obtained but, also, the ratio of the duration of inspiration to expiration can be varied at will. Such a cabinet, therefore, permits a true artificial respiration independent of the efforts of the patient. Respiration may be uninterruptedly continued with the use of such an apparatus even though the patient be suffering from respiratory embarrassment whatever the cause, whether from an overdose of ether, or from morphine or gas poisoning, or from suffocation by smoke. By this apparatus we have kept a fully curarized dog alive for four hours.

The apparatus, also, permits of the perfect control of the head of the patient by the anaesthetist in case of vomiting or the necessity of cleaning out the pharynx or passing an instrument into the oesophagus or stomach.

By the lever (*D*) used to vary the rate of respiration and the lever (*E*) which varies the ratio of the duration of inspiration to expiration the movements of the diaphragm are under control. We consider this to be an important factor contributing to the success of intrathoracic operations. We know of no form of apparatus which combines in this way the advantages of the larger cabinets and direct insufflation.

The pioneer work of Sauerbruch in thoracic surgery has stimulated renewed interest in artificial respiration. Within only a few years rather numerous forms of apparatus for this purpose have been devised. In general, they may be divided into four classes. First, the negative or positive pressure chambers (Sauerbruch^{4, 5}, Willy Meyer^{6, 7}; second, the positive pressure cabinets (Brauer^{8, 9}, Murphy,¹⁰ Janeway and

Green¹; third, the positive pressure masks (Robinson^{11, 12}, Tiegel¹³; and fourth, the various devices for direct insufflation through the trachea (Fell,¹⁴ Fell-O'Dwyer,¹⁵ Doyen,¹⁶ Matas,¹⁷ Green,² Volhard,¹⁸ and Meltzer¹⁹). Only extended trial upon the human subject will decide which of these various forms of apparatus is best adapted to general use; and probably for a long time in the future they will all be continued to be used according to the preference of this or that surgeon. We desire, therefore, to state our reasons for preferring the one herein described.

As opposed to the negative pressure chambers we can see no difference whatever between negative or positive pressure. Neither do we believe that any advantage will ever accrue to the use of differential pressures of definite heights, in place of utilizing the normal atmospheric pressure for one of the two pressures in any operation conducted under differential conditions. Our own experiments do not confirm the observations of Robinson and Sauerbruch (*Deut. Ztschr. f. Chir.*, 1909, cii, 542; and *ANNALS OF SURG.*, 1910, li, 320). Since these publications have appeared one of us (H. H. J.) has removed the whole lung of one side from a consecutive series of five dogs, and each one has made an uninterrupted recovery.

The elaborate apparatus constructed by Willy Meyer will furnish further evidence upon the relative merits of positive and negative pressure. While complicated, it after all surrounds the patient with the simplest conditions, and as a result of our personal experience through the invitation of Dr. Meyer we believe that the mechanism is perfect and furnishes to the operator and the anæsthetist every convenience. While believing it to be an ideal apparatus, nevertheless the adaptability to easy transportation of the smaller positive pressure cabinets often amounts to more than a mere convenience. The valve mechanism permitting the rhythmic rise and fall of pressure within the cabinet is an important addition, and, we believe, is more perfectly adapted to cabinets of small size than to the larger rooms.

The objection to the use of the third class of apparatus

for artificial respiration consists in the fact that access to the mouth and pharynx is greatly impeded by them.

Concerning the fourth method of artificial respiration our judgment is yet in abeyance. The method is the oldest form of artificial respiration. It was used as early as 1829 by Monroe, Goodwin, Hunter, North and John Murray (quoted from Matas). On account of accidents depending upon excessive pressure of air within the lungs the method fell into disuse. Dr. Fell of Buffalo deserves the credit of again using the method and of being the first man to demonstrate its real value. Too much credit cannot be given to Dr. Fell for his persistent efforts and successful pioneer attempts in perfecting an apparatus for artificial respiration by insufflation of air through the trachea.

The instruments of Doyen, Matas and that formerly employed by one of us represent attempts at further improvement of virtually the same method. A greater variation attempted by Volhard, two years ago, is the continuous insufflation of oxygen through an intratracheal tube.

Robinson¹¹ repeated Volhard's experiments, and going a step further tested artificial respiration by continuous insufflation of the trachea with air, instead of oxygen, in exactly the same manner that Meltzer has now adopted.

Meltzer, however, deserves the credit of further perfecting this method and of demonstrating that in it we have a valuable means of artificial respiration for thoracic surgery.

We consider this method the best improvement of all those of the fourth class. Its success, we believe, depends upon the fact that when a soft rubber tube of a certain size is introduced far enough within the trachea there is some resistance offered to the air passing out of the trachea around the tube. The failure to recognize this fact undoubtedly explains why this method has never been used before. We believe as a result of our own work that the amount of distention of the lung present when the Meltzer apparatus is used proves that there is present an intratracheal positive pressure of at least 5 mm. The respiratory movements of the animal do not

cease, unless the pressure is raised to a definite height, and when only one side of the thorax is opened, due to the weight of the chest walls, the lungs are alternately filled and emptied of air. Meltzer encourages this and advises the complete exhaustion of air from his system of tubes two to five times a minute. We believe, however, that when both sides of the chest are opened or the animal be suffering from morphine poisoning, that it will be desirable to increase the frequency of this exhaustion. The method, therefore, must be viewed as a true positive pressure method and is surely more than its name "continuous insufflation" indicates. As Willy Meyer has emphasized, the method, though seemingly simple, really affords to the patient more complicated conditions than when the pressure cabinets are used. This is true for the simple reason that the cabinets, particularly if supplied with the mechanism for alternately increasing and decreasing the pressure of air within them, can accomplish all that Meltzer's method does and can do it without the additional factor of the presence of a tube within the trachea. We do not, however, wish to state that this addition should be considered an objectionable one unless it shall be demonstrated to be injurious.

Through the kindness of Dr. Meltzer we have used his method with his own apparatus in his laboratory and our experience with it on this occasion was most satisfactory. The operation, which was a long one, passed off as smoothly as any that we have ever performed. During the operation we filled the mouth of the animal with a suspension of charcoal in water. None of this solution was drawn into the trachea. This single observation, therefore, confirms Dr. Meltzer's experience that the return current of air prevents the inhalation of fluids from the mouth. The small size and the inexpensiveness of his apparatus are important considerations favoring the adoption of his method. Nevertheless, for the present at least, we prefer our cabinet for the following reasons. In the first place, the true status of any form of artificial respiration is not yet established. Though not so easily portable nor so cheap as

intratracheal tubes, our positive pressure cabinet can be, nevertheless, easily transported. Otherwise it possesses all the advantages of warming the inspired air, diluting the ether vapor, ease of application, control of the patient's head, and possibility of inducing respiration independent of the efforts of the patient, that cannot be claimed for any other method. By its use there is also more uniformity and gradualness in the variations of air pressure than is the case with direct intratracheal insufflation; nor is the ether blown so directly into the lungs. We believe also that our cabinet permits of the absorption by the patient of less ether. For two reasons this is true. First, when the head of a patient is surrounded by a positive pressure there exists a certain degree of cerebral anæmia which in turn renders less ether necessary for surgical narcosis. Sauerbruch^{20, 21} has even made use of this fact in controlling hemorrhage in cerebral operations. Again, the mere fact that the patient is so completely artificially respired with air mixed with ether vapor renders it an extremely difficult matter to give the minimum amount of ether required. In our experience with intralaryngeal insufflation what would have been otherwise a toxic dose has frequently been absorbed by the animal. In this connection it is necessary to distinguish between the amount of ether used during an operation and the amount actually absorbed. Less may be used and yet more absorbed. We judged of the amount absorbed by the effects upon the animal after stopping artificial respiration. These factors are perhaps not of paramount importance, but in any surgery it is desirable to take advantage of every means contributing to the interest of the patient.

Finally, there is some place for an apparatus for artificial respiration which can be quickly used by those unskilled in passing tubes within the trachea or by nurses. Fire departments should be supplied with such a form. Nothing could be more easy in its application than the slipping of a rubber collar over the neck of the patient, the head of the patient when so incased remaining completely under the control of the attendant.

Fig. 3 illustrates the modification of the button described by one of us (N.W.G.) before the American Medical Association in 1908²⁰ and has proved of definite value in the lateral anastomosis of the stomach with the œsophagus. By the pressing together of the opposing halves of the button through the approximated and unopened walls of the œsophagus and stomach a union of these viscera is effected without the slightest contamination of the field of operation, and more rapidly than it can be done by any other method. By the use of this button we have shortened the operation by at least half an hour. Surely when operating in such a cavity as the pleural cavity where inflammatory processes can originate from much less exposure than within the abdomen, such a gain in time must be considered an important factor.

Fig. 4 illustrates another modification of the same button that has been designed by the other of us (H.H.J.) for the union of the resected end of the œsophagus and the lateral wall of the stomach. It makes possible an end-to-side anastomosis through the closed viscera without the exposure of an infected surface. A purse-string suture passed around the œsophagus is pulled tight, the œsophagus is then divided distally to the ligature and the stump placed between the needle points. The male half is then approximated through the wall of the closed stomach and the two halves pressed together. The needles and blade penetrate and engage the thread of the male half.

Until recently we had had our only successful cases of typical gastro-œsophageal resections within the thorax by the use of this button, and no successful cases where the anastomoses had been accomplished by suture. We attributed this fact, at that time, to the aseptic manner in which the anastomosis had been performed, and felt confirmed in our opinion by the experience of Sauerbruch^{22 23 24} and Tiegel.²⁵ Lately, however, a number of considerations have influenced us to try the suture method again. In the first place, upon a number of occasions the button has slipped from its holder during the pressing of the two halves together. Again, it is important

for the button to be adapted in size to the particular animal upon which it is used, and finally, the needles and blade must be very sharp. Though these elements are always under control, yet we have felt that any satisfactory instrument should have more latitude in the conditions permitting its successful use. These considerations, and the fact that our latest experience with the suture has been more favorable, have influenced us to doubt the advantage of the use of a button for the union of the oesophagus with the stomach after a resection of a portion of both these organs. The objections above mentioned do not apply to the use of the button for a lateral anastomosis. Its use for this purpose is a decided gain and has transformed such an operation in our hands into a, comparatively speaking, safe procedure. In the operation for resection, however, the choice between the needle and thread and the button may be still debatable.

By a special technic developed by one of us (H.H.J.) we have been able to resect one to one and one-half inches of the oesophagus and all of the stomach but the pylorus. We now have (February, 1910) three perfect recoveries out of five operations of this kind. In all the needle and thread has been used to accomplish the anastomosis. We believe, therefore, that this operation will have a definite field of usefulness. Our experience in oesophagoscopy leads us to believe that a large proportion of oesophageal strictures begin in the stomach or just at the cardiac sphincter, and that in many the stomach is the most important viscus involved.

Only through the thorax can successful approach be obtained to the cardiac end of the stomach and distal end of the oesophagus; and an operation which permits of successful removal of some of the oesophagus and a large portion of the stomach must have a definite utility.

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CANCER OF THE ŒSOPHAGUS AND CARDIA.*

A DESCRIPTION OF AN OPERATION FOR ITS REMOVAL BY THE TRANSTHORACIC
ROUTE UNDER CONDITIONS OF DIFFERENTIAL PRESSURE.

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AND

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THE development of the Sauerbruch idea, rendering accessible to surgical attack the interior of the thorax, led to the hope that carcinoma of the lower portion of the œsophagus would be soon amenable to radical removal. The fatal issue, however, of the few operations of this character which have been undertaken, and the rather indifferent results of animal experimentation have somewhat cooled the interest in this province of surgery. Nevertheless the field is an important one, for carcinoma of this region is by no means of infrequent occurrence. There are to be considered not only the strictly œsophageal tumors but also cancer of the proximal portion of the stomach. The contiguous parts of these two organs, anatomically different, form one surgical region. Rokitansky¹ first formulated the rule that the duodenal walls do not become involved in cancer of the pylorus, while cancer of the cardiac portion of the stomach regularly extends to the œsophagus. For cancer of the pylorus, Lebert² found only one exception to this rule in 34 autopsies, and Brinton³ ten in 125. Few exceptions also exist at the cardia for the converse of the conditions at the pylorus. Fenwick⁴ and Robson⁵ comment on the frequency with which cancer of the oral portion of the stomach invades the œsophagus. Fawcett,⁶ out of 36 cases of malignant disease of the stomach

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occurring between the years 1826 and 1900, found 26 cases in which the cardiac orifice was involved. Of these one was a sarcoma, and, of the remaining 25, 16 had invaded the œsophagus for some distance. In all the 25 cases the stomach walls were the seat of the disease for a distance of three or four inches.

It is, therefore, a matter of interest to estimate the general frequency of œsophageal and gastric cancers, and to know what proportion of these growths in the case of each organ is situated at or near the cardia. With this end in view the accompanying tables have been constructed.

GENERAL FREQUENCY OF ŒSOPHAGEAL CANCER.

Albrecht⁷ from the Obushow Hospital records between 1873 and 1877, found 27 œsophageal cancers.

Krusenstern⁷ from the Obushow Hospital records between 1873 and 1883, found 44 œsophageal cancers.

Stroganow⁷ from the Odessa Hospital records between 1877 and 1887, found 44 œsophageal cancers.

Von Hacker⁷ from the Billroth Clinic records between 1877 and 1886, found 131 œsophageal cancers.

Cölle⁷ in Göttingen, 1877 to 1886, found 17 œsophageal cancers among 1650 patients.

Rebitzer⁷ in Munich, 1854 to 1889, found 29 œsophageal cancers from 15,168 autopsies.

Ludewig⁸ in Göttingen, 1898 to 1905, found 48 œsophageal cancers from 9339 patients.

RELATIVE FREQUENCY OF CANCER OF STOMACH AND ŒSOPHAGUS

	Stomach	Liver and gall-bladder	Uterus	Breast	Rectum or rectum and intest.	Œsophagus	Total number of cancers or individuals
Borstell ⁽⁷⁾	32.5%	.....	14.7%	.....	.....	5.9%	217 cancer cases.
Aschoff ⁽⁹⁾	1571	464	580	252	418 incl. intest.	217 (4.79%)	4574 cancer cases.
Frief ⁽¹⁰⁾	2147	757	.....	.....	407 incl. intest.	359	
Feilchenfelds ⁽¹¹⁾ (1901).....	165	.....	45	.....	56 incl. intest.	58	
Reichmann ⁽¹²⁾ (1902).....	288	.....	105	1	140 incl. intest.	77 (10.8%)	711 cancer cases.
Bashford ⁽¹³⁾	14,468	11,531	11,714	8428	6389	2832 (3.35%)	84,448 cancer patients for 3 yrs. '01-'03 in England and Wales. (2086 cancers of tongue.)
Prinzling ¹⁴ (1907) .	3.13	1.66	2.5	.9	.....	3.125	To each 10,000 inhab.
Redlich ¹⁵ (1907)...	176	38	52	27	59 incl. intest.	55 (11%)	496 cases.
McConnell ¹⁶ (1908)	33.7%	13.5%	27.6%	15.7%	44.7%	.....	To each 100 deaths from cancer.

DISTRIBUTION OF ŒSOPHAGEAL CANCER

	Year	At beginning of œsophagus	At bifurcation of trachea	At cardia
Habershon ⁷	1857	33	30	10
Petri ⁷	1867	2	13	8
MacKenzie ⁷	1875	44	28	22
Zenker and v. Ziemssen ⁷	1878	2	1	6
Krusenstern ⁷	1885	3	30	14
Morosow ⁷	1887	10	18	61
Morosow (prep.) ⁷	1887	3	2	4
Collé ⁷	1887	15	63	84
Johansen ⁷	1888	29	47	82
Voight ⁷.....	.....	4	17	41
v. Hacker ⁷.....	.....	13	53	65
Wright ¹¹.....	.....	36	48	35
Piggar ¹²	1899	3	12	10
Mampell ¹⁰	{ 1889-1904	*6	14	30
	{	†7	29	37
	{	*1	46	60
Hampeln ²⁰	{	†6	12	110
Sauerbruch ²¹	1905	26	43	117
Ludewig ²	1905	3	16	23
Slavyanis ²²	1908	10	5	28
		256 (15%)	527 (32%)	847 (52%)

* Autopsy. † Klin. cases.

DISTRIBUTION OF CANCER OF THE STOMACH

	Pylorus	Cardia	Lesser curvature	Rest of stomach
Brinton ³ (1865).....	219	36		105
Gussenbauer and Winiwarter ²³ (1876).....	542	58	65	209
Lebert ²⁴ (1878).....	10	5		1
Welch ²⁵ (1900).....	791	104	148	257
Osler and McCrae ²⁶ (1900).....	27	3		18
Fenwick ⁴ (1902).....	173	24	29	39
Colwell ²⁷ (1906).....	149	19		59
Makkas ²⁸ (1907).....	134		18	24
Daniel ²⁹ (1908).....	225	4	61	26
	2270 (63%)	253 (7.6%)*	321 (8.9%)*	738 (23%)

* Total number of cases occurring in the cardia and lesser curvature equals 16 per cent.

A review of these tables will justify the conclusion that cancer of the stomach forms from 20 to 30 per cent. of all cancers, and that of this proportion 16 per cent. belong to the cardia and lesser curvature and 7 per cent. to the cardia alone. Taking the figures of Bashford¹³ to be the most accurate as a basis for calculation, we would have 2387 carcinomas of the cardia and lesser curvature, and 1099 of the cardia alone among 84,448 cancer cases occurring in England and Wales between the years 1901 and 1903. If we now add

to these numbers 52 per cent. of all œsophageal tumors (1472) we will have from 2570 to 3859 tumors situated at or near the cardiac orifice of the stomach for the same period—a number in either case greater than Bashford's statistics for carcinoma of the tongue and nearly equal (in its upper limits) to 50 per cent. of the number of cancers of the breast, a notoriously frequent form of carcinoma. One source of error may exist in the above method of calculation. It is possible that in the table showing the distribution of cancer of the œsophagus, a number of gastric growths may be included. Admittedly, for an absolutely correct calculation only such series of cases should be used which include both tumors of the œsophagus and stomach, and are at the same time coupled with a pathological report. Of 30 specimens of malignant disease from all portions of the œsophagus, Perry and Shaw³⁰ found that every one, with the exception of two sarcomas, was a squamous cell epithelioma, while of 44 gastric carcinomas, of which three involved the cardiac orifice, 12 were cylindrical celled carcinomas and 32 were spheroidal celled carcinomas. Haberkaut³¹ makes the following classification of 88 gastric cancers: scirrhus 32, adenocarcinoma 20, medullary carcinoma 18, "gallert" carcinoma 18. In the Matti series scirrhus carcinoma is very rare. Of the cases numbered from 53 to 97 cylindrical celled carcinoma occurred 12 times, carcinoma simplex 5, carcinoma colloides 5 times, and carcinoma medullare once, scirrhus 1, and mixed forms 12 times. There were no epitheliomas. It is excessively rare to find carcinoma as distinguished from epithelioma originating in the œsophagus. Franke³² has reported one case and refers to two others as curiosities.

We have used, however, the only data which we have been able to find, and such as they are we believe that they indicate a fair approximation to the truth. They at least clearly demonstrate the surgical importance of the cardia, and justify a serious effort in attempting to remove growths in this situation.

A number of considerations render carcinoma of the stom-

ach peculiarly suitable for radical attack if only the technical difficulties of the operation and of the early diagnosis can be overcome.

Gussenbauer and Winiwarter,²³ on the basis of the autopsy material of the Vienna Pathological Institute between the years 1817 and 1873, found 223 instances out of 542 pyloric carcinomas in which the tumors were well isolated, and of these 172 had scarcely any extensions to the surrounding organs; 41.1 per cent. of operated cases were stated to be free from metastases and 37.7 per cent. possessed no external growth. Ledderhose,³³ of 39 cases from the autopsy material of the Strassburg Pathological Institute, found 10 per cent. of such cases. Streit,³⁴ between the years 1876 and 1886 of the autopsy material of the Bern Pathological Institute, found 25.9 per cent. of these cases. Rydygier,³⁵ agreeing rather with the results of Ledderhose, found of 52 operated cases only 9.6 per cent. without extension beyond the stomach. Kramer,³⁶ of 66 cases operated upon, found 26 with extensive external growths and calculated that 33.3 per cent. are operable. Haberkaut,³¹ of 59 cases operated upon, found 20 with no external extension. Makkas²⁸ found no enlarged glands in 14 cases out of 167, and, out of the same number, in 46 only was there extension to neighboring organs. The table on page 73 shows the proportion of resections performed by the various operators and indicates the proportion of operable tumors of the stomach. It also shows the increasing number of permanent cures.

These results are the more remarkable when we remember the comparatively late period at which many patients submit to operations. In practically 90 per cent. of the cases a diagnosis is not reached until a tumor or resistance can be felt through the anterior abdominal walls. Out of 167 cases reported by Makkas,²⁸ there were only 10 in which no tumor or resistance could be felt. Of the Matti⁵⁰ series, a tumor existed in 77.3 per cent. and a resistance in 8.2 per cent. Of 50 resected cases reported by Creites,⁴⁰ only 3 came for treat-

ment inside of the first three months. Only eight presented themselves before six months from their first symptoms, and 39 submitted to operation between six months and one year, and 10 between 1½ years and 6 years. Of 665 cases reported by Hoffman,⁵¹ 25 were operated upon inside of the first two months, of which 4 were resected, 117 inside of three months, of which 24 were resected, 187 between three and six months, of which 53 were resected, 303 at six months, of which 77 were resected, 193 between six months and one year, of which 58 were resected, 144 after one year.

Of 285 cases reported by Daniel,²⁹ 35 were operated on before two months from their first symptoms, 78 between two and three months, 77 between four and six months, 81 between seven and twelve months, 49 later than one year.

Leaving out of consideration the technical difficulties of resection at the cardia, the accessibility of this portion of the stomach to direct observations through the gastroscope should render it possible to obtain the same if not better results than at the pylorus. From our own experience we are convinced that it is not a difficult matter under local anæsthesia thus to remove bits of tissue for microscopical examination from growths even though situated some distance within the stomach. We base this belief upon the fact that we have confirmed the diagnosis of gastric carcinoma involving the cardiac orifice by the removal of bits of tissue through the gastrosopic tube, and upon the fact that in the normal individual we are able to examine the cardiac portion of the stomach for a distance of three or four inches. Though our observations cover as yet a limited number of cases, it is certain that the large number of inoperable growths of the stomach would not exist if the gastroscope could be introduced as a routine method of examination in all new gastric cases.

The preceding discussion is necessary not merely to show the importance of the surgical field at the cardia, but to define just what this field is, and to demonstrate that the cardiac portion of the stomach is as important if not more important, than the lower end of the œsophagus, and must be included

in any plan of operative attack directed against carcinoma of this locality.

The introduction of thoracic surgery under conditions of differential pressure has demonstrated the accessibility of both these regions. Notwithstanding, however, the good exposure which this method of operating affords, every intrathoracic oesophageal operation thus far undertaken has been fatal.

OPERABILITY OF CANCER OF THE STOMACH.

Author.	No. cases.	No. resections.	Mortality.	No. traced.	Died later.			Well when rep.	Cases well over 3 yrs.
					½-1 yr.	1-2 yrs.	2-3 yrs.		
Rydygier ³⁷ (1901).....	100	25	17	22	2	1			
Clairmont ³⁸ (1905) (Eiselsberg).....	258	32	6	...	7	6	2	6	2
Mayo ³⁹ (1906).....	100	100	14	63	17	8	2	65	5
Creite ⁴⁰ (1907, Braun)...	211	50	19	...	24 (16 mo. - 1 yr.)			6 (6 mo. 1-½ yrs.)	1
Makkas ⁴¹ (1907) Mickulicz.....	458	167 (4 ex-tirp.)	1891-'08, 25 out of 55; 1899-1900, 9 out of 40; 1901-'04, 23 out of 68	82	21	26	6 (6 died of recurrence bet. 4-6 yrs. later)	27	3
Riese ⁴¹ (1908).....	89	24	7	...				5 (7 mos. - 5 yrs.)	1
Daniel ³⁹ (1908).....	395	73	21	71	40	10	29% operable		
Derjushinsky (1909) quoted from Rasumowsky.....	...	6	1						
Rasumowsky ⁴² (1909)...	...	5	2 (1 in 17 days from hemiplegia)						
Kocher ⁴³.....	...	92	14 (2 out of last 21)	...					18
Kindl ⁴⁴ (1909).....	112	16	7						
Poncet ⁴⁵ (1909).....	169	40	14	18	7	7		5 (½-5½)	2
Kocher ⁴⁶ (1909).....	...	144	4†	100					22
Mayo ⁴⁷ (1910).....	...	266*	34	88					18½

Leriche⁴⁸ has collected 93 cases from various authors free from recurrence 3 years after operation.

Paterson⁴⁹. 86 resections, of which 21 have lived for 3 years and 12 for 5 years.

* 117 previous to 3 years ago. † Out of last 44. ‡ 13 over 4 years; 8 over 5 years.

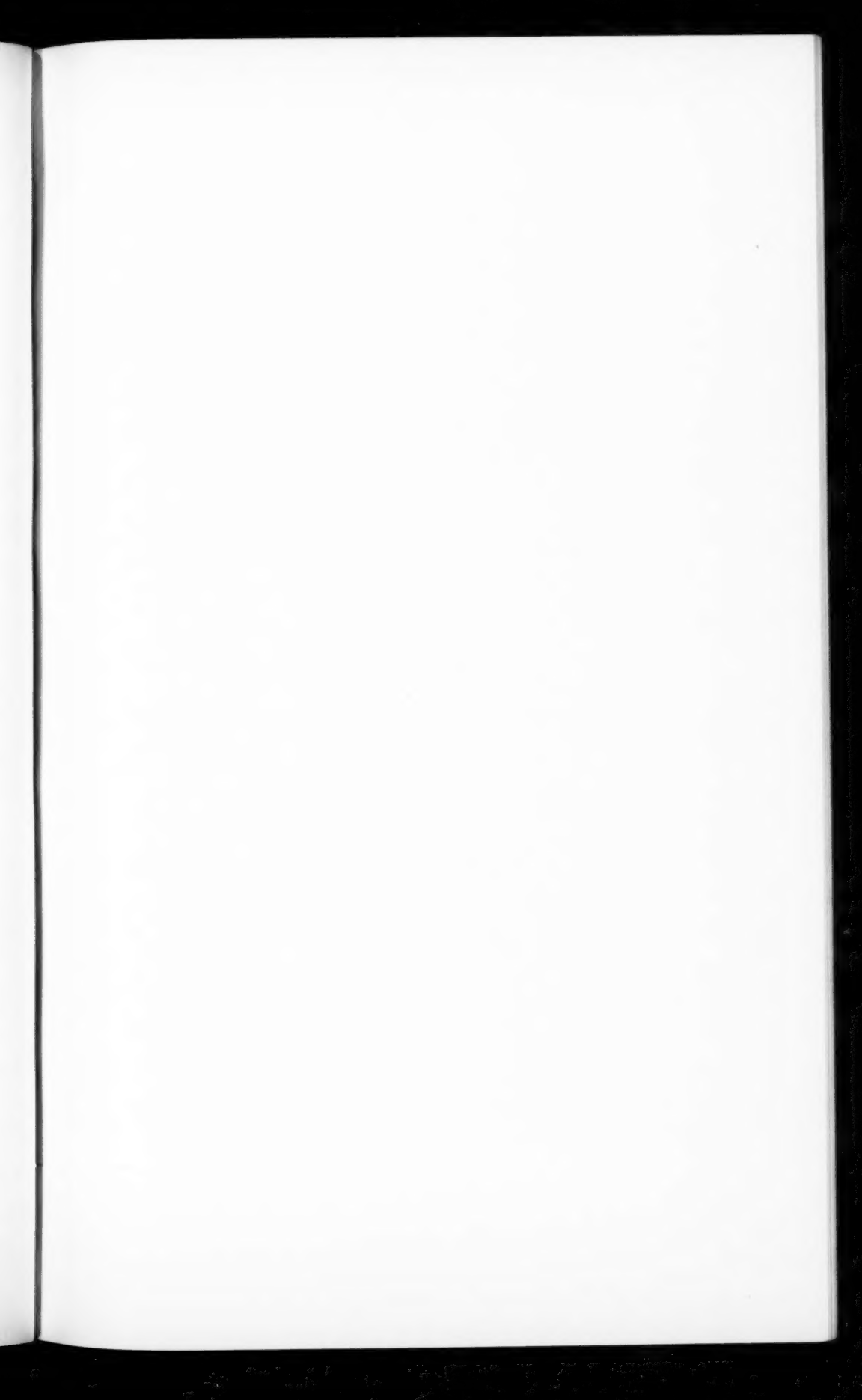
Only about 15 (10 by Sauerbruch) have been performed, and of these the most noteworthy are three attempted resections (Sauerbruch,⁵² Wendel,⁵³ and Tiegel⁵⁴).

Concerning operations upon animals, we are unacquainted with any successful series of typical resections of what would constitute a satisfactory length of oesophagus and stomach. Sauerbruch⁵⁵ has stated that in his hands an anastomosis by

suture has failed, and his only successes have been obtained by either an anastomosis with the lateral wall of the œsophagus or by a two-staged operation in which at first the cardia is invaginated into the stomach and subsequently amputated through an abdominal gastrotomy. Tiegel's experience confirms that of Sauerbruch, but in order to save length of the œsophagus, and to avoid the formation of a blind pouch, he has devised a special button which permits of an anastomosis of the end of the œsophagus with the lateral wall of the stomach. He reports only one animal which lived after such an operation. Our first experience confirmed the views of both these workers. In the first series of resections in which the end of the œsophagus was anastomosed to the lateral wall of the stomach by suture, every animal died. We, therefore, also adopted the use of a button, a modification of the one described by one of us (N. W. G.), which had materially facilitated in his hands the operation of œsophagogastrostomy without resection. This button enabled us to make an aseptic union of the end of the œsophagus with the lateral wall of the stomach. The results, however, were not good, only 5 out of 60 dogs lived.*

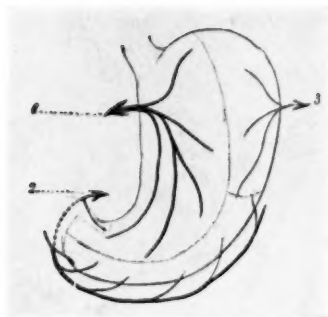
These results and certain other considerations led us to attempt an entirely differently planned operation. We became convinced that the preservation of perfect asepsis was not the solution of the problem. Willy Meyer⁵⁴ and Carrel⁵⁵ had each accomplished one successful resection of a limited portion of the gut by an end-to-end union with suture. On the only two occasions upon which we have performed a plastic operation upon the wall of the thoracic œsophagus, we have obtained permanent healing in spite of considerable soiling of the pleural cavity with intra-œsophageal fluid. Further than this, no one of the procedures, thus far described as successfully worked out upon animals, permits of anything but the removal of a very limited segment of the œsophagus and

* It is important to note in connection with what follows that these dogs did not vomit and lived until they were killed, 3 to 8 months after their operations.





General view of the subperitoneal network of the stomach, injected by Gerota's method (Cunéo). 1, left pneumogastric; 2, præcardiac glands; 3, right pneumogastric; 4, coronary artery; 5, coronary vein; 6, gland of the small curvature; 7, hepatic artery; 8, right gastro-epiploic artery; 9, subpyloric gland; 10, right gastro-epiploic vein ending in the middle colic vein.



Lymphatic territories of the stomach (Cunéo). 1, the coronary or the principal current; 2, right gastro-epiploic current; 3, splenic current

stomach. The worst of them all in this respect is the union of the lateral wall of the stomach with the lateral wall of the œsophagus (Sauerbruch and Wendel). A valuable length of the gut is thus sacrificed in a location where every millimetre counts. The same criticism to a lesser degree is true of an anastomosis of the end of the œsophagus with the lateral wall of the stomach (Tiegel⁵⁴ and Green and Maury⁵⁸). The sacrifice of distance by this procedure is also great and in addition results in the placing of a considerable weight upon the circle of union and much difficulty in the repair of the diaphragm.

In order to render an operation of resection of the cardia of practical utility, we believe that, first, an end-to-end union is necessary, and, second, that the stomach must be removed down to at least the prepyloric region. Only by adopting such a method can the parts be reunited without tension and the disease, against which this operation is designed, wholly eradicated. Aside from what has been previously mentioned regarding the situation of malignant disease of the lower portion of the œsophagus, a study of the lymphatic supply of the stomach will demonstrate why it is desirable to resect most of the lesser curvature. Cuneo⁵⁹ has shown that the lymphatic vessels of the cardia and lesser curvature of the stomach converge toward the point at which the gastric branch of the cœliac axis approaches the stomach returning over the course of distribution of the branches of this vessel. The accompanying cuts have been photographed from his work. Such a lymphatic distribution is perhaps one reason for cancer of the cardia so often invading the stomach for a considerable distance. It is, therefore, not simply for the purpose of broadening the scope of operation for cancer of the cardia that it is desirable to amputate so large a portion of the stomach, but rather to eradicate also, in one piece, the associated lymphatics.

We believe that an operation planned in the manner which we have indicated in addition to the advantages already outlined is also far more practical from a technical stand-point than any other hitherto described. We have mentioned the poor results which we have had in our first two series of dogs

in which we made limited resections. In our last series, however, operated upon by a method worked out by one of us (H. H. J.), herein described in detail, and to which reference is made in the preliminary report on page 58, an end-to-end anastomosis is made with suture and the stomach is resected as far as the prepyloric region, thus utilizing the pyloric portion of the stomach to bridge the gap left by the resected gut. Of this series 10 dogs have made perfect operative recoveries out of 17, and of the last six only one was lost. These dogs healed well and continued to live for four weeks to two months after the operation. During this time they seemed in perfect health except for more or less vomiting. As a rule they redevoured and eventually retained a good deal of their vomitus. Between four weeks and two months after operation all of the dogs died in an emaciated condition. With the exception of one dog which had an ulcer of the stomach and another which died of pneumonia, the autopsies revealed a perfectly normal mucosa from the beginning of the oesophagus to the end of the duodenum. Nothing pathological was found in the other organs, and we believe that the dogs must have died from inanition. Pachon and Caballo⁶⁰ have shown that a dog may gain in weight and remain in perfect health after the removal of the entire stomach. The greatest care as regards feeding was conspicuous in their experiment. If it had been possible for us with the help at our command to have given our dogs an equal amount of care, particularly concerning the frequent feeding of small quantities, they might have continued to live.

It has seemed to us that the subsequent death of our animals was due to an insufficient amount of food passing the pylorus, and this in turn dependent upon two factors, first, a loss of propulsive force on the part of the stomach and, second, the presence of a more or less unrelaxing pylorus. Contributing toward the first of these factors are both the absence of a sphincter at the cardia and the failure of the stomach walls to receive vagus stimulation, this nerve having been divided as a consequence of the operation. Contributing toward the

second of these factors is the loss of any inhibitory action of the vagus upon the pyloric sphincter.

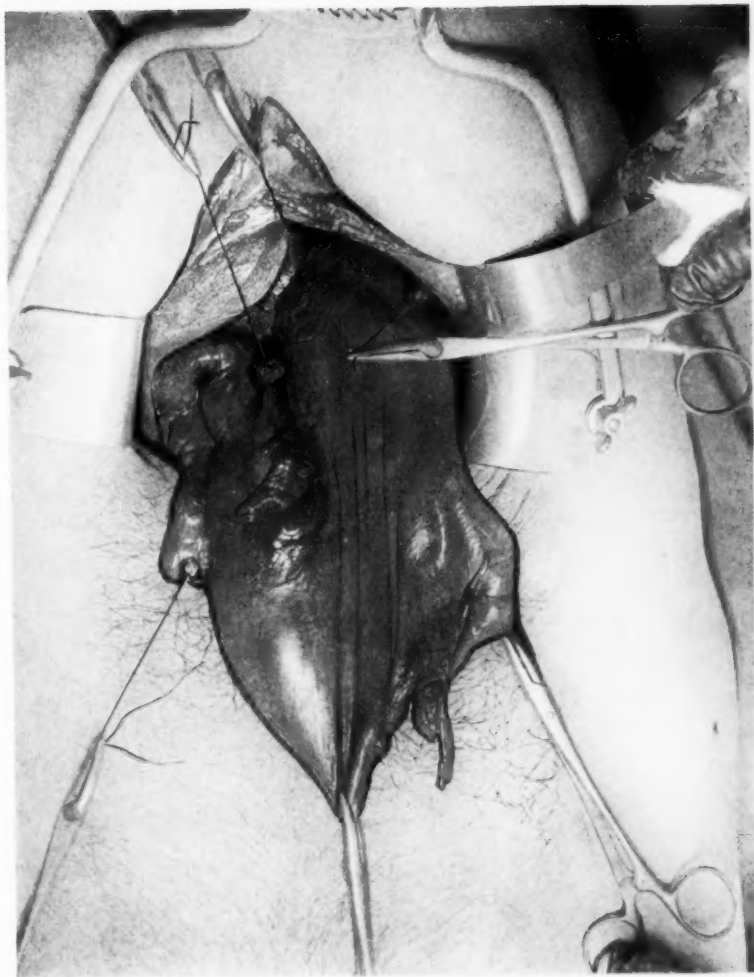
In human beings, to whom it is possible to give better care in the matter of feeding, death may not follow in the same manner. Paterson⁴⁰ has collected 27 cases of total gastrectomy in the human being. Of these 17 have made perfect operative recoveries and lived in health for some time later. At the time of his report 12 were still well. Since then Moynihan⁶¹ has reported another case and Pauchet⁶² and Viannay⁶³ each two additional ones. There is abundant evidence, therefore, that the mere removal of the stomach is not a fatal operation. Should, however, the resection of the lower extremity of the œsophagus with the cardiac portion of the stomach as far as the pyloric region present in human beings the same difficulty which we have met with in the dog, two additional operations which we have performed both successfully and consecutively indicate the proper method of overcoming the trouble. In these operations the same œsophago-gastrectomy was performed, but with the additional step of the division of the pyloric sphincter down to, but not through, the mucous membrane; and repair of the incision, as in pyloroplasty, by sewing the wound up in the direction of its length. These dogs eat well and practically have not vomited since the operation. They present a marked contrast to all the other animals referred to, and thus far (three and four weeks after operation) have held their weight. In the end-to-end anastomoses which we have performed upon dogs, the larger opening upon the stomach side has not first been narrowed down after the first method of gastroduodenostomy by Billroth, but the redundant portion of the mucous membrane around the opening into what remains of the stomach is gathered in by a running stitch, which sews the œsophageal mucosa to the mucous membrane of the stomach, taking more stitches through the latter than through the former.

The series which we present is small and our work may be held to be still incomplete because of the fact that no dog has yet lived longer than 2½ months. Nevertheless, we believe

that as far as it has yet gone it is worth reporting and demonstrates the technical possibilities of the operation which we are discussing. In the first place, a successful end-to-end suture in the type of operation which we have described has not yet been accomplished to our knowledge by any other observer. Secondly, it offers a very considerable number of advantages over the methods hitherto advocated for dealing with carcinoma of the cardia.

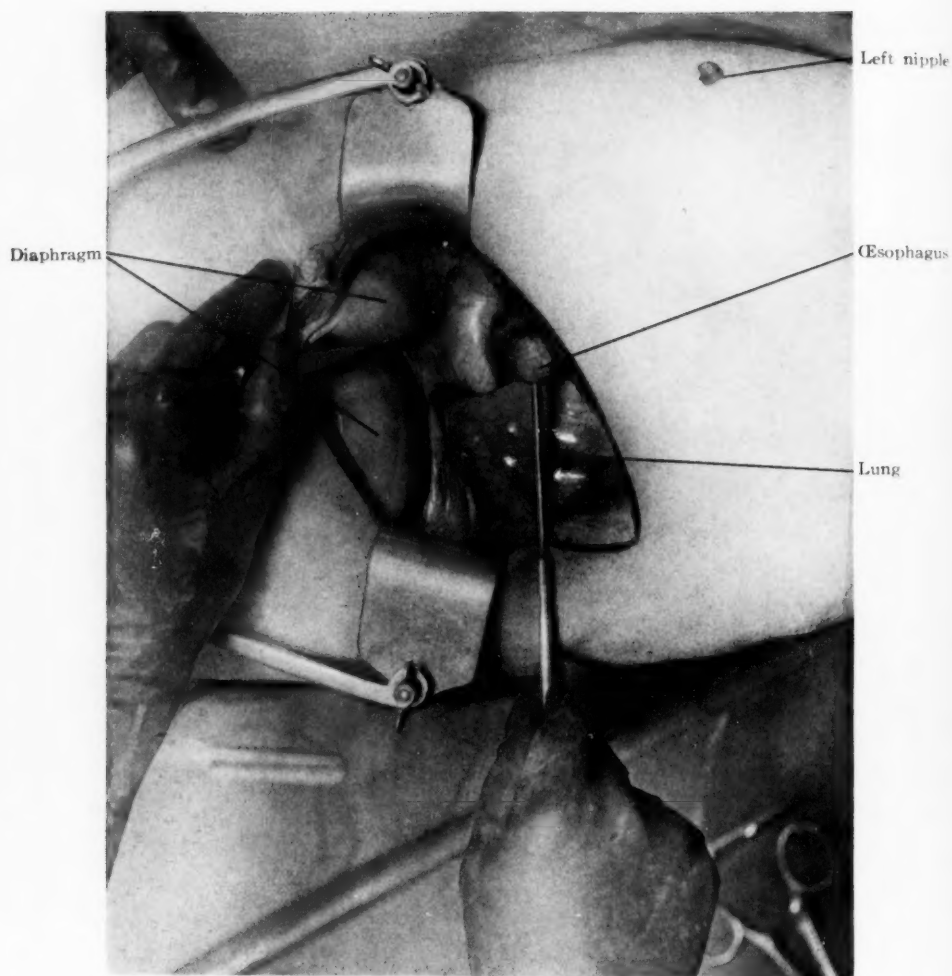
We have worked out the details of this operation upon the human cadaver and photographed the various steps. The reproduction of these photographs shows how real are the advantages claimed. In the dog the entire operation is performed through the thorax, but in the human being it is much more convenient to do the first stage within the abdomen. Figure 1 represents the stomach delivered through a median abdominal incision. The gastric, pyloric, and right and left epiploic arteries are tied and the lesser and greater omenta have been divided. The patient is now turned on the side and the eighth rib is resected. The costal cartilages of the next one or two ribs above are divided, and self-retaining retractors are inserted. Figure 2 illustrates the œsophagus hooked forward. The fold of the left crus of the diaphragm is in front of it, and the tip of the lower lobe of the left lung is at the side. The pneumogastric nerves may now be separated from the œsophagus. Should this prove impossible they may be divided. We have divided the pneumogastric nerves immediately before they pierced the diaphragm in five dogs (this being the only operative procedure on these animals). Two of these dogs died suddenly about five to six weeks after their operations. The autopsy revealed no cause for their death. The mucosa of the stomach showed, contrary to the opinion of Zironi⁶⁴ no sign of ulceration. The other three dogs are alive and healthy. An incision is now made between the left crus and the œsophagus into the peritoneal cavity. Through this opening the stomach may be pulled up. This procedure renders it very easy to tie off the gastrohepatic and gastrosplenic ligaments.

FIG. 1.



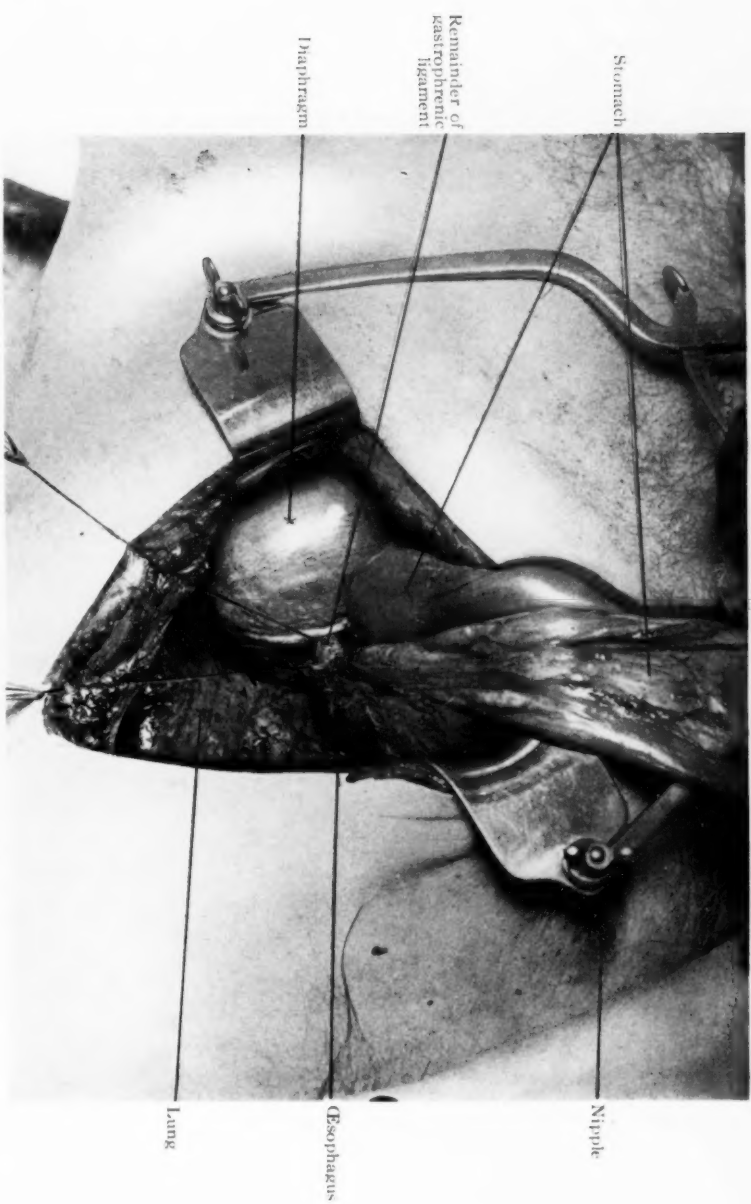
Stomach delivered through median abdominal incision.

FIG. 2.



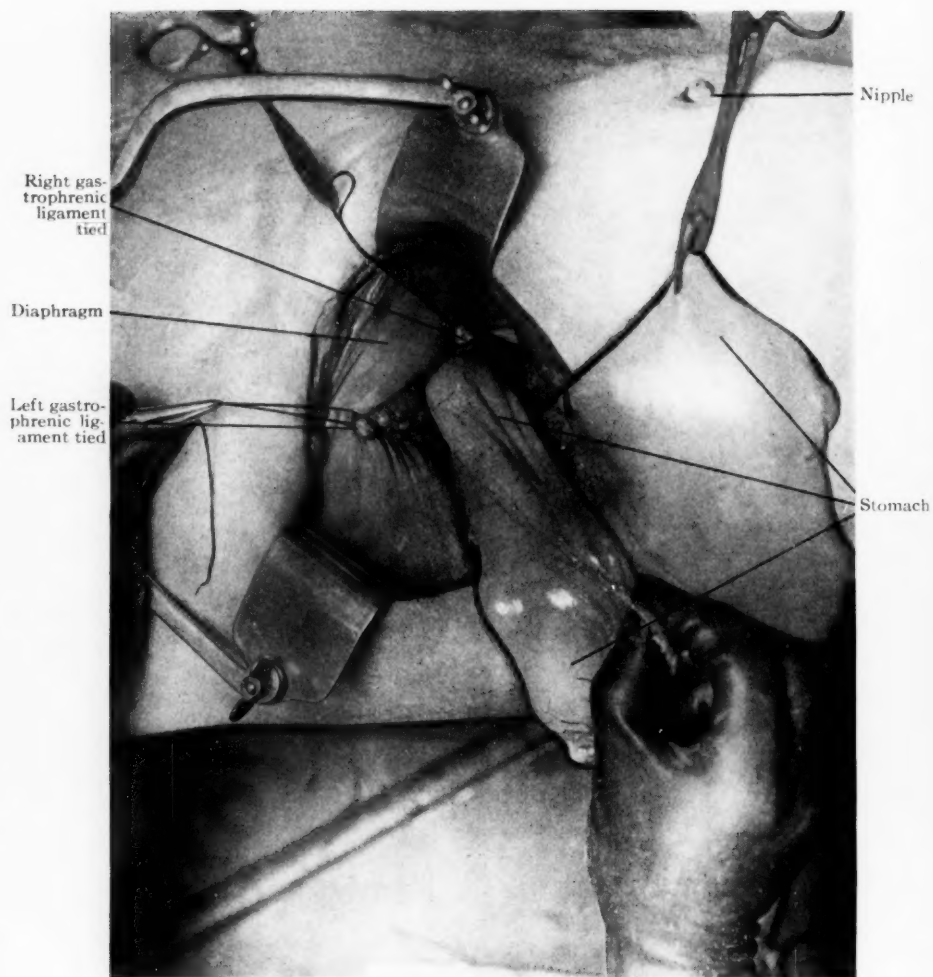
Chest open through floor of eighth rib. Esophagus hooked forward over aneurism needle which crosses the left lower lobe of lung. Diaphragm held down by spatula.

Fig. 3.



Stomach pulled into the thoracic cavity. Pylorus emerging through the diaphragm to left, and esophagus disappearing behind lung to right. Ligature passes around the remnants of the left gastrophrenic ligament.

FIG. 4.



Gastrophrenic and gastrohepatic ligaments tied, and stomach and esophagus entirely free within the thorax.

FIG. 5.

Diaphragm

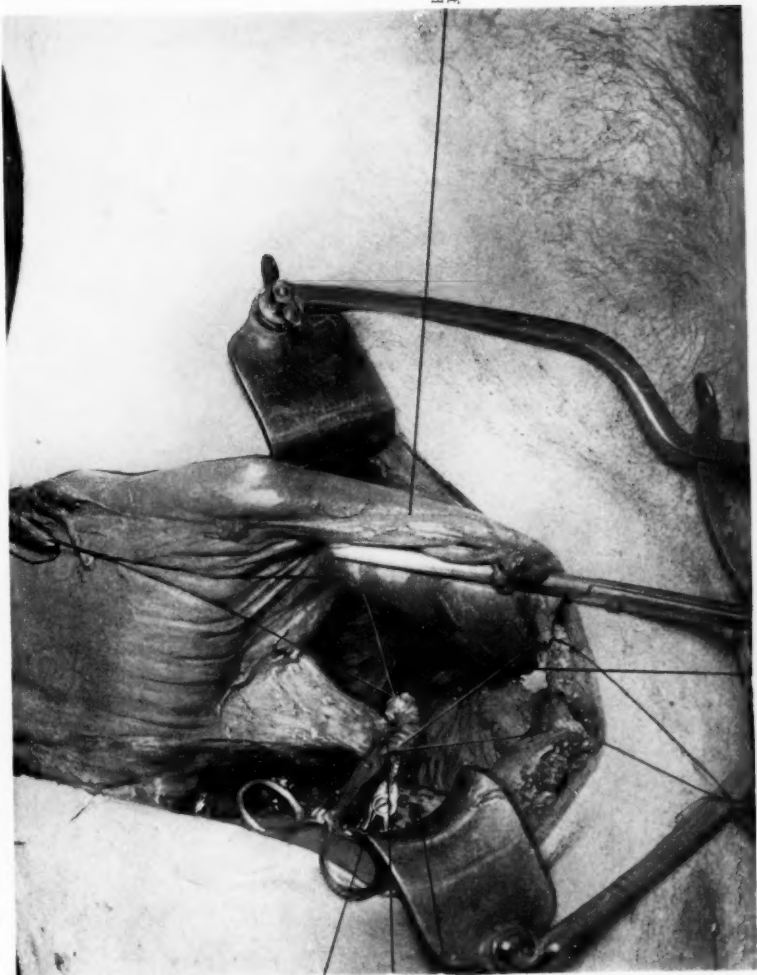
Nipple

Lung

Esophagus clamped

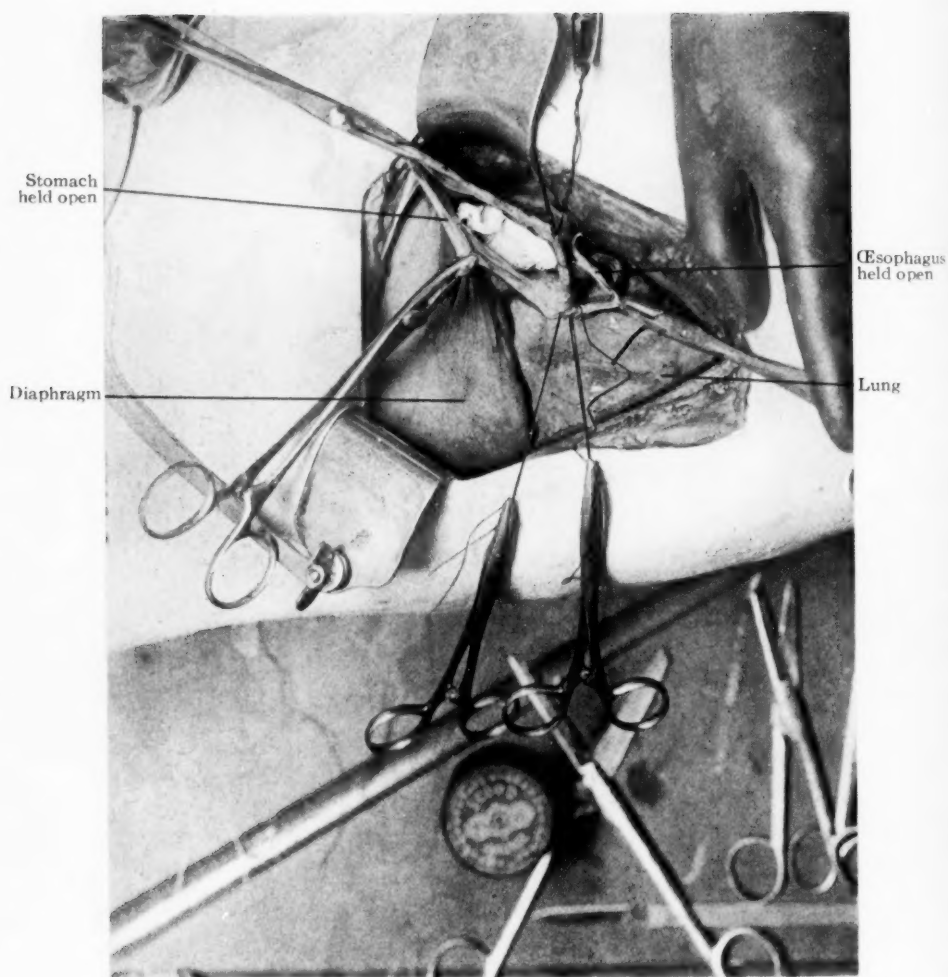
Spring clamp on
esophagus to prevent
sealing.

Pyloric portion of
stomach clamped



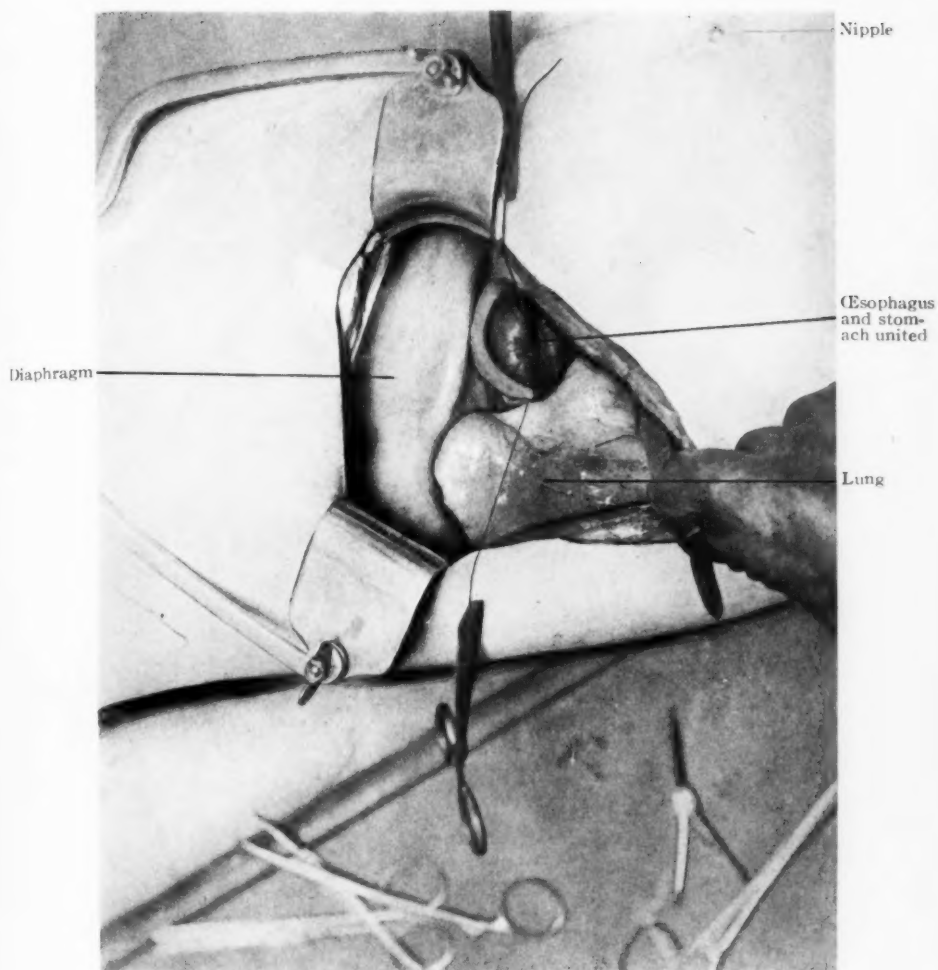
Portion of stomach and esophagus to be amputated between the clamps.

FIG. 6.



Divided stomach to left and œsophagus to right. The mucosa of the two organs have been sewed together for half the distance around each. Diaphragm to left and lung below and to right. Sponge has been placed within the open lumen of the stomach.

FIG. 7.



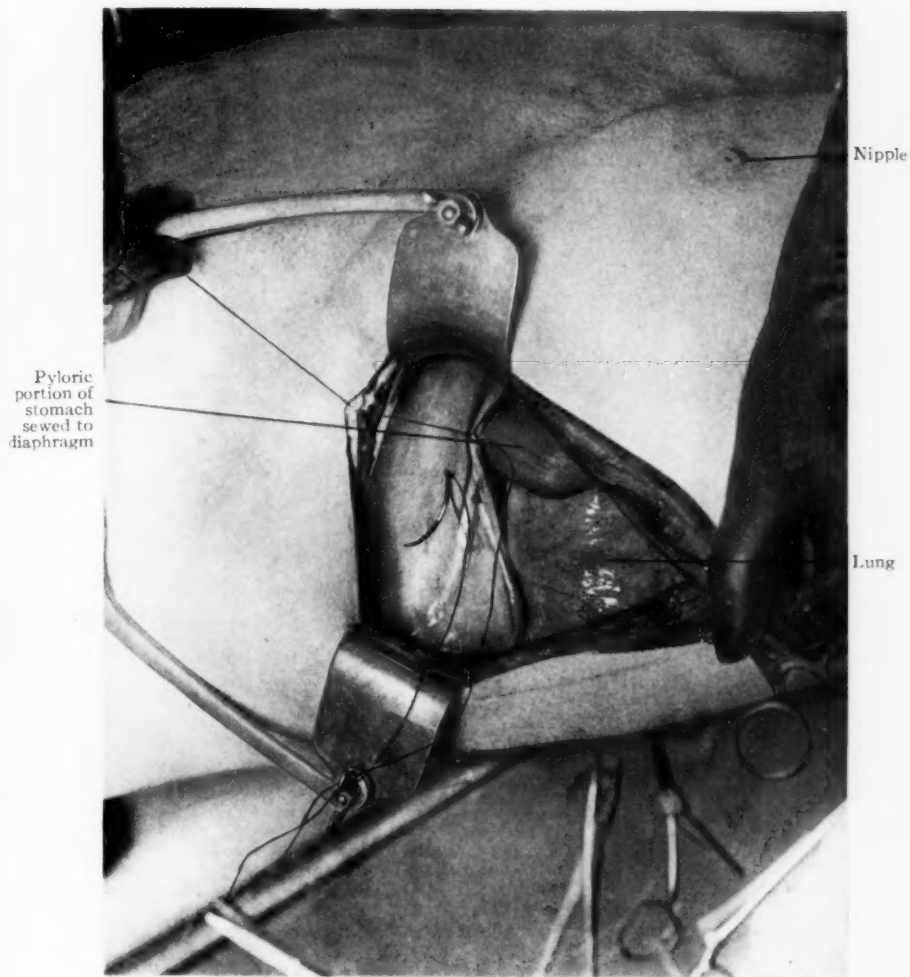
Shows the mucosa of the stomach completely sutured to that of the esophagus, and the anterior serous covered walls of these viscera ready to be united by the external layer of sutures.

FIG. 8.



The stitching of the serosa of the stomach to the anterior pleural covered wall of the esophagus has been completed in front, and this illustration shows the posterior walls of these two organs pulled around to the front in order that the external layer of sutures may be completed all the way around.

FIG. 9.



Pyloric portion of the stomach being sutured to the opening through the diaphragm. The line of suture between stomach and œsophagus is covered by lung.

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Figure 3 shows the stomach delivered into the thorax and a ligature passed around the remainder of the left gastro-phrenic ligament. Figure 4 shows the right and left gastro-phrenic ligaments tied off, and the stomach and oesophagus entirely free within the thorax. Now the resection may be completed and it is easy to see from the photograph how readily the resected portion of the oesophagus may be replaced by the pyloric end of the stomach, permitting in this way an anastomosis without tension. Figure 5 shows the portion to be resected isolated by two clamps, and two retention sutures placed on each side above and below the clamps. A light spring clamp is now applied to the oesophagus above, and the whole area well padded off. The portion to be resected is now removed by the scissors. The two retention sutures previously tied hold the open ends of the gut together. By a running suture, which Figure 6 shows completed for one-half the circle of an anastomosis, and all the way around in Figure 7, mucous membrane is sewed to mucous membrane. The redundant portion of the stomach mucous membrane is gathered in by taking more stitches through it than are taken through the oesophagus. External to this layer a row of interrupted silk sutures uniting the peritoneal surface of the pylorus to the external wall of the oesophagus finishes the anastomosis. The anterior walls of these two organs are first sewed together and lastly, by simply pulling the gut around by the retention sutures, the posterior half is completed. Figure 8 shows the anastomosis completed, and Figure 9 the gut being sewed to the margin of the opening through the diaphragm.

CONCLUSIONS.

1. The aboral end of the oesophagus and the cardiac portion of the stomach must be considered as one surgical region.
2. Cancer in this location is by no means infrequently met with.
3. We believe that it permits of an early diagnosis by means of the gastroscope.

4. An operation of practical utility for resection of cardiac cancer must remove not only a portion of the œsophagus but also a considerable part of the stomach, in particular the lesser curvature.

5. Such an operation can be accomplished without undue tension by an end-to-end anastomosis with suture.

6. By an operation of this character it has been possible for us to obtain 10 operative recoveries out of 17 dogs and 5 out of the last 6.

7. As a preliminary report it may be stated that the death of the recovered animals about six weeks after the operation is due to an interference with the normal physiology of the pylorus, and may be prevented by the simple pyloroplasty herein described.

8. From a technical stand-point such an operation can easily be performed upon the human being.

POSTSCRIPT.—Since returning the manuscript of the above to the printers the authors have operated upon a patient with cancer of the cardiac portion of the stomach involving the œsophagus, by the method which they have herein described. The patient had had symptoms for the preceding nine months, and the operation required was an unusually severe one. The spleen was involved in the carcinomatous mass and was removed in one piece together with the stomach and lower portion of the œsophagus. The patient died fifty-four hours after operation, of empyema, starting, apparently, in a small perforation situated in the circle of anastomosis, a complication which we believe can be more carefully guarded against in the future. This experience, however, and the condition of the specimen removed demonstrate that the technic employed was satisfactory and that the operation is feasible and justifiable. In the future, instead of making two incisions in extensive cases, we should advise the use of one incision beginning a little posterior to the axillary line over the eighth rib, running over this rib to its cartilage, then curving downwards, and ending at the umbilicus. Through this incision the costal cartilages attaching the lower ribs to the sternum may be

divided, and a good approach obtained to the upper abdomen and the thorax. The chest should not be opened until the completion of the intra-abdominal work. We desire to thank Dr. Geo. Brewer for material assistance rendered at this operation.

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ON THE EXPERIMENTAL SURGERY OF THE THORACIC AORTA AND THE HEART.*

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INTRODUCTION.

DURING the last winter, I performed some experiments with the view of improving the general technic of intrathoracic operations and of finding special methods which could be used for the treatment of certain diseases of the heart and of the aorta. It is probable that the aneurisms of the thoracic aorta could be extirpated and the circulation re-established by a vascular transplantation, if a proper technic was developed. It seems possible, also, that some valvular and vascular diseases of the heart might be improved by surgical therapeutics. Nevertheless, the surgery of the heart has been limited entirely to the treatment of the wounds. A few experimental studies of this subject, however, have been made in the laboratories of Frederick in Marburg and of Harvey Cushing in Baltimore. But, in spite of their comparative simplicity, these experiments have been followed by a heavy mortality. Their results and the high death rate given by the operations on human beings show that the general technic of intrathoracic surgery is still insufficiently developed. Therefore, before describing the special methods that I found, it is necessary to study the procedures which permit the use of them without great danger.

GENERAL TECHNIC.

The bad results following the intrathoracic operations in experimental as well as in clinical surgery are due to a lack of adaptation of the technic to the physiological conditions of

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the chest. The complications which often kill the animal or the patient are brought about directly or indirectly by the infection of the pleural or pericardiac cavities, or by the respiratory disorders caused by the penetration of the air into the thorax.

Pleural infection is the more dangerous of these complications. In one hundred fatal cases of wounds of the heart treated by suture, death was the result of sepsis sixty times. The constant failure of the extirpation of œsophageal cancer is due generally to the same cause. The experimental results are also very far from being satisfactory. Many animals operated by Sauerbruch and Haecker in Germany, or by Bernheim, Robinson, Janeway, and Green in this country died of purulent or serofibrinous pleuresis, or of pneumothorax caused by the secondary opening of a bronchus or of the thoracic wall. Nevertheless, the operations were generally not very complicated and extensive. The high death rate is due to the lack of understanding by many surgeons that pleura and pericardium do not react against infection as peritoneum does. The technic which permits a successful abdominal operation may be insufficient when used in intrathoracic surgery. The degree of infection which does not interfere with the healing *per primam intentionem* of a wound can probably cause the failure of certain vascular or thoracic operations. It is well known that between absolute asepsis and the degree of infection which produces the ordinary symptoms of inflammation there is a number of intermediate stages. The so-called aseptic wounds are almost always slightly infected. Often surgical asepsis is merely a condition of non-suppurative infection. But the attention of the surgeons has not been attracted by the various forms of attenuated infection, because it does not prevent the healing of ordinary wounds. Nevertheless it seems probable that the more marked states of non-suppurative infection can be very dangerous in intrathoracic surgery. It is, therefore, necessary to use in vascular and intrapleural operations better asepsis than it exists in many hospitals and laboratories.

This higher degree of asepsis can be obtained by the rigid application of principles known by every surgeon, but often neglected partially in the management of the operating rooms, the preparation of the patient, of the operators, the handling of the tissues, etc. The success of the more complex intra-thoracic operations depends on the observance of a number of minute details of technic. It is necessary mainly to remove some of the principal factors of irritation and inflammation of the pleuræ during the operation. The handling with forceps or retractors, the sponging, or the walling off with gauze, the exposition of large surfaces to the air bring about irritation of the pleura and facilitate greatly its infection. As soon as the thoracic cavity is opened, the lungs must be covered with fine Japanese silk compresses, impregnated with vaseline. The silk tissue acts as a thin and almost impermeable membrane which protects the pleura, without irritating it, against the contact of the fingers, and permits a very efficient walling off of the operating field. At the same time, it prevents the evaporation and the desiccation of the surface. In order to prevent the cooling of the viscera, a piece of thick flannel is placed on the silk compresses. Besides, the temperature of the operating is very high, 29 or 30° C. It is important not to allow the blood to flow through the pleural cavity. The sponging of the pleural cul-de-sac may be a cause of infection. All handling of the unprotected pleura or pericardium is dangerous.

The usefulness of a rigid asepsis is shown by the results which were obtained. I made twelve operations similar to those performed by previous experimenters, resection of pulmonary lobes, resection of a small segment of the middle part of the œsophagus, simultaneous opening of both pleuræ and pericardium, dissection of mediastinum and ascending aorta. It must be remembered that the suture of the œsophagus gave such constant mortality that Janeway and Green thought success was not possible and devised a very ingenious and complicated method for œsophageal anastomoses. Again, Sauerbruch, Robinson and others found that secondary pneu-

mothorax may follow lung resections, and Willy Meyer developed a very elaborate method for closing the bronchial stump. Nevertheless, I did not use those technics. I employed only the simplest sutures or ligatures, and the animals, without exception, recovered. Although this technic has given better results than those obtained by previous experimenters, it is still far from being ideal. After more complicated operations like patching of the vena cava, graft of vessels on the heart, simultaneous operations on the heart and the descending aorta, when very large exposure of the thoracic cavity is rendered necessary, I observed some serofibrinous or purulent pleureses. On twenty-eight operations of that class, seven times this complication occurred. Several animals died of secondary hemorrhage from aortic patches or cardiac sutures, and it is possible that the infection played also a rôle in these complications. Nevertheless there is no doubt that even in very complex operations, septic complications can be avoided. It is of great importance for the future of intrathoracic surgery that this part of the technic is completely developed.

The asphyxia which follows the opening of the thoracic cavity may be due to the pneumothorax, to a spontaneous stopping of the respiration, or to the inefficiency of the respiratory movements produced by a large opening or a strong retraction of the thorax.

The asphyxia produced by pneumothorax is easily prevented by the use of a Sauerbruch or Brauer chamber. Recently Willy Meyer and his brother Julius Meyer have built a splendid apparatus, which combines the advantages of both methods. On man, unilateral pneumothorax is not very dangerous and extensive intrathoracic operations have been performed without any apparatus. But it is very much safer to use a positive or negative pressure apparatus, which prevents completely the respiratory troubles caused by the pneumothorax.

When asphyxia is produced by the spontaneous stopping of the respiration, the Sauerbruch method becomes inefficient,

and does not prevent the patient or the animal from dying. In the more extensive operations, when the chest is widely opened, and the thorax dislocated by a strong retraction, the ribs and the diaphragm cannot act any longer on the lungs, and asphyxia occurs. In these cases also the Sauerbruch method cannot prevent the death of the animal. On the contrary the life of the animal will go on normally, if the Meltzer and Auer method of intratracheal insufflation is used. Their method has the very important advantage over all the others of permitting the respiratory exchanges to continue even if the respiratory movements have stopped or become inefficient. The apparatus I used is composed of only a foot-bellows, a rubber tubing connected with an ether bottle, and a manometer, and a small intratracheal catheter. With the method of Meltzer and Auer, the spontaneous respiration becomes a luxury because even when the respiratory movements cease or become inefficient, the ventilation of the lungs still goes on and the animal remains in excellent condition. By its simplicity and its efficiency, the method of Meltzer and Auer is a great advance in experimental surgery. It is actually the safest method for performing extensive operations on the chest.

Among the factors which bring about the success or the failure of an intrathoracic operation, the more important is not the apparatus which prevents the respiratory disorders caused by the pneumothorax. The main danger is not asphyxia, but infection, as it has been demonstrated by the results of many experimental and clinical operations in this country and in Europe. The technic must be improved, therefore, by better asepsis rather than by complicated apparatuses.

SPECIAL TECHNIC.

I attempted to find new methods which could be used for the treatment of the aneurisms of the thoracic aorta, and of the valvular and vascular diseases of the heart.

The diagnosis of the aneurisms of the aorta can be made to-day at a comparatively early period. It is rational to think that some of them can be extirpated. Therefore we must find

methods which permit repair to the aortic wall after a partial or complete resection.

We know that the lumen of an artery can be reduced without interruption of the circulation by the operation I described a few years ago as longitudinal exclusion. This method could be used for a sacciform aneurism, with narrow pedicle. But, in most cases, a resection of a part of the wall or of a complete segment would be necessary. I have already demonstrated that after a partial resection, an arterial wall can be patched with a piece of artery, of vein, or even with a piece of peritoneum. These operations present very little danger, and their results, observed many months after the graft, were excellent. I succeeded also in substituting to a part of the abdominal aorta a piece of rubber sheeting. The circulation went on normally and is still normal after several months. In a number of other operations, I found that entire segments of veins and of arteries, fresh or preserved in cold storage, can be transplanted on arteries. The results observed after several years are excellent, and the operation performed under certain conditions is very safe.

The patching and grafting of entire vascular segments would permit the re-establishment of a normal circulation after resection of a sacciform or fusiform aneurism. But, the technic must be adapted to the special anatomical and physiological conditions of the intrathoracic aorta. Its wall is exceedingly friable, especially in the ascending part of the arch. It is very easily cut by the threads. It has, therefore, been necessary to modify in a large measure the ordinary technic of vascular suture. The sutures and anastomoses on the thoracic aorta are less difficult but more dangerous than on the other arteries. Every detail of the technic must be directed toward the prevention of secondary hemorrhage. This complication is liable to occur after aortic suture, while it does never happen after suture of the abdominal aorta and other arteries. Parietal thrombosis, which is generally a very dangerous complication, does not produce any trouble when it develops on the aortic wall. On account of a possible

hemorrhage it is more dangerous to graft a piece of vessel on the thoracic aorta than on another artery.

It was necessary also to find out a method for diverting the blood during the operation, because the aortic circulation cannot be interrupted for a long time without the occurrence of nervous complications. The main danger of the aortic operation does not come from the heart or from the aorta itself, but from the central nervous system. When the descending aorta is clamped for more than ten or fifteen minutes, the posterior limbs become paralyzed. It is generally a spastic paralysis. The lesions are localized to the cells of the anterior horn. It seems that the clamping of the ascending aorta cannot be continued without danger for more than one minute. A smaller operation like the suture of a wound can be performed in less than one minute. We can also make a circular suture of the descending aorta in six and even in three minutes. But the resection of an aneurism, and the graft of a vessel would take a very much longer time. Therefore, I tried to develop a technic for the temporary diversion of the blood.

The diversion of the blood can be produced in two different ways—by temporary intubation of the aorta or by an artificial collateral circulation, *i.e.*, a *central* or *lateral* diversion of the blood.

The *central* diversion consists of tubing the segment of the aorta which is to be resected. The vessel is laid open by a longitudinal incision and a paraffined tube is inserted into its lumen and temporarily fastened. This small operation involves only a short interruption of the circulation. Then the wall of the aorta can be extirpated and replaced while the circulation goes on through the tube. When the operation is completed, the tube is removed through a small incision in the wall of the aorta. There is no danger of coagulation of the blood in the tube during the operation. The patching or the transplantation of an aortic segment can always be performed in less than an hour, while the circulation can go on for several days through the tube before coagulation occurs.

It is a safe and convenient method for the descending aorta. It can be probably used also on the ascending aorta.

The *lateral* diversion consists in establishing a communication between the left ventricle and the descending aorta, or between two parts of the aorta. I have used only the first method. The anastomosis between the left ventricle and the descending aorta is made by means of a paraffined rubber tube or of a large jugular vein preserved in cold storage. One end of the vessel or of the tube is inserted into the apex of the left ventricle and fastened. The other end is inserted into the descending aorta. The ascending aorta is clamped. Then the blood goes directly from the left ventricle to the descending aorta. The direction of the blood stream is reversed through the upper part of the descending aorta, which acts temporarily as an ascending aorta. There is, therefore, no danger of anæmia of the brain. But the operation is still very dangerous because the details of the method are not sufficiently worked out. The mortality was heavy. Before being safe the technic must be considerably improved. Nevertheless, I succeeded several times in anastomosing the left ventricle to the descending aorta and in reversing the circulation through the upper part of the descending aorta, after clamping the arch of the aorta just above the heart. In one experiment the anastomosing tube was very much narrower than the arch of the aorta. As soon as the ascending aorta was clamped, the heart began to beat slowly, and the blood passed with a strong thrill from the ventricle to the descending aorta. In the brachiocephalic arteries pulsations and a marked thrill were felt. The coronary vessels were dilated. The circulation was thus maintained for eight minutes. The animal remained in excellent condition, and when the clamp and the tube were removed, the circulation was re-established in its normal direction. Nevertheless the lateral diversion is still very much more difficult and dangerous than the aortic intubation.

Although my technic was being developed during the course of the experiments and is still far from being perfected,

some new and permanent results were observed. In one experiment the ascending aorta of a dog was incised and sutured by Jaboulay stitches. Two months and a half after the operation, the vessel was examined. The wound had healed perfectly and the scar was very small. In six experiments the transverse suture of the descending aorta was performed, after complete or incomplete section. One dog died of secondary hemorrhage a few weeks after the operation. The others recovered completely. One of them was chloroformed two months and a half after the operation. The anastomosis was found normal without dilatation or stenosis. The remaining dogs are in normal health more than five months after the operation. The patching of the aorta with a piece of vein was made twice. The animals died eight days and twelve days after the operation of secondary hemorrhage. The accident was due to necrosis of the flap in the one case and in the other to the tearing of the flap by a stitch. These complications can be prevented by slight modifications of the ordinary technic. I performed once only the graft of a complete venous segment between the cut ends of the descending aorta. The operation was performed five months ago. The animal is still in excellent health and there is no modification of the femoral pulse. It is, therefore, probable that with the help of the methods for temporarily diverting the blood, certain aneurisms of the aorta on man can be removed and replaced by a piece of vein.

I attempted also to find out some method for the treatment of valvular diseases and localized sclerosis of the coronarian arteries. Theoretically, many operations can be performed on the heart,—incision and dilatation of stenosed valves, cuneiform resection and stenosis of the upper part of the ventricle in case of mitral insufficiency, curettage of endocardiac vegetations, grafting of new vessels on the auricle and ventricle, collateral circulation between two cavities of the heart, aorto-coronarian anastomosis, etc. The development of these technics is not far advanced for I have studied the conditions under which the operations must be performed rather

than the operations themselves. Plastic operations on the heart are not very much more difficult than on any other parts of the body. But to perform the operations without disturbing in an irreparable manner the functions of the nervous system and of the heart itself is a very complicated problem.

The cardiac operations can be artificially divided into three classes: operations which do not require the hæmostasis of the heart, operations which require the hæmostasis for a very short time, and operations which require the hæmostasis for a longer time and the stopping of the heart.

1. Several operations can be performed without the help of the temporary hæmostasis, such as digital exploration of the ventricles or the auricles, dilatation of the mitral valve, dissection and preparation of a coronarian vessel for anastomosis, incomplete ventriculectomy and suture, etc. I tried to develop an operation for mitral insufficiency which could be performed without opening the heart. It consists of producing a slight stenosis of the upper part of the left ventricle. It can be obtained by a partial cuneiform resection of the wall of the ventricle just below the coronary artery. A dog which has undergone this partial ventriculectomy two months ago is still in good health.

2. In the operations of the second class, the cavities of the heart are open for about one minute, during which time it becomes possible to insert and fix a tube or vessel into the ventricular or auricular cavities, to open largely and to suture the ventricular wall. It would be feasible also to cut a mitral or tricuspidian valve, or to perform the curettage of endocardiac vegetations. I tried to determine what are the best conditions under which that type of operation must be performed. The hæmostasis can be secured by the clamping of the venæ cavæ as advocated by Sauerbruch. But it is simpler to clamp with a large soft-jawed forceps the entire pedicle of the heart. As the interruption of the circulation does not last more than one or two minutes, it causes no cerebral complications. The main danger is the occurrence of fibrillary contractions, which render almost impossible the

re-establishment of normal pulsations. I performed clamping of the heart eight times, with or without cardiotomy, for from one to five minutes. One dog died of respiratory complication, another one of fibrillary contractions, because the needle went through the dangerous region of Cyon, and the others recovered. In case of mitral stenosis, it would be easy to make an incision of the valve. It would be probably possible also to establish an indirect auriculoventricular anastomosis by a vein implanted on the left auricle and ventricle. I succeeded in fastening temporarily a tube into the left auricle and ventricle. The blood was circulating through it with a strong thrill. At the end of the operation, the tube was removed. The animal remained in good health.

3. To the third class belong the operations requiring the interruption of the circulation for a longer time. They would consist of more complicated plastic operations on the cardiac wall, and of the operations on the coronarian arteries. In certain cases of angina pectoris, when the mouth of the coronary arteries is calcified, it would be useful to establish a complementary circulation for the lower part of the arteries. I attempted to perform an indirect anastomosis between the descending aorta and the left coronary artery. It was, for many reasons, a difficult operation. On account of the continuous motion of the heart, it was not easy to dissect and to suture the artery. In one case I implanted one end of a long carotid artery, preserved in cold storage, on the descending aorta. The other end was passed through the pericardium and anastomosed to the peripheral end of the coronary, near the pulmonary artery. Unfortunately, the operation was too slow. Three minutes after the interruption of the circulation, fibrillary contractions appeared, but the anastomosis took five minutes. By massage of the heart, the dog was kept alive. But he died less than two hours afterwards. It shows that the anastomosis must be done in less than three minutes. Perhaps this can be done by using a lateral implantation with a Payr's canula.

The safest method of performing a comparatively long

operation would be to suddenly place the heart in a condition of anæmia. It is well known that the heart loses its excitability very slowly, and that, by using a proper method, it can be revived after a long period of immobility. We do not know exactly for how long it is safe to keep the heart motionless. But the complete stopping of the circulation is more dangerous for the organism than for the heart. The artificial stopping of the circulation and the opening of the cardiac cavity would place the patient in the condition of a man killed by a bullet through the heart immediately after the last respiration and the last cardiac pulsation. This condition is called general death. But it is merely unmanifested life or latent life. The organs, being deprived of circulating blood, are not able to manifest life any longer. But they are still living and could revive, if they were given back their normal physico-chemical conditions. Latent life is a very instable state. Without the circulating blood, the tissues are not able to protect themselves against the microbes and the autolytic ferments, which bring about progressively protoplasmic disintegration, that is, elemental death. Immediately after the artificial stopping of the heart, the organism is placed in a condition intermediary between general and elemental death. This condition is, from a medicolegal standpoint, death. Nevertheless, as long as elemental death has not taken place, the organism can be resurrected. Therefore, the length of the period during which we can stop the heart safely depends on the rate of the development of elemental death. The brain disintegrates first. It is well known that complete ischæmia of the encephalon produces irreparable lesions. Nevertheless, a short interruption of the circulation is not very dangerous. On a dog, the chest was widely opened, and respiration stopped while the pedicle of the heart was clamped for five minutes. Then the clamp was removed and pulmonary ventilation started again by the Meltzer and Auer method. The animal was easily revived. He recovered completely and never presented any psychological troubles. It is known that, when the interruption of the circulation lasts longer, very marked

cerebral lesions occur. I found also, that in an animal, revived after a long period of cerebral ischaemia, the upper nervous centres had disintegrated. The functions of the heart and of the lungs were almost normal. But the animal was paralyzed and appeared to have lost his intelligence and sensitiveness.

The time during which an animal can be maintained without great danger in a condition of latent life is very short. The technic must, therefore, be developed in such a manner that no cardiac operation should last more than five minutes. It seems possible, although dangerous, to stop the circulation and the respiration during that period and afterwards to replace the animal in a condition of normal life.

CONCLUSIONS.

1. The general technic of intrathoracic operations has been improved by the use of a better asepsis and of the Meltzer and Auer method of pulmonary ventilation.

2. Two methods for the diversion of the blood during the operation on the thoracic aorta have been found,—intubation and lateral diversion.

3. For the first time, it has been possible to perform with permanent success a suture of the ascending aorta, several end-to-end anastomoses of the descending aorta, and the grafting on the descending aorta of a segment of vein preserved in cold storage.

4. It has been attempted also to find and to study new cardiac operations, and the conditions under which they must be performed.

The technic of these operations is far from being completely developed. They must not be used on human beings under their present form. Their purpose was only to study some of the principles on which must be based the future surgery of the thoracic aorta and of the heart.

TREATMENT OF WOUNDS OF THE HEART.*

WITH REPORT OF TWO CASES.

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WOUNDS of the heart have for many ages been considered fatal, and it was not until within recent years that the surgery of this organ has been attempted. While cardiac injuries are comparatively infrequent, they are, however, of such seriousness that prompt surgical interference is demanded. It is for this reason that surgeons should be acquainted with a definite plan of procedure in the treatment of these emergencies.

The first surgical operation on the human heart was performed by Farina, of Rome, in 1896, and since this time the heart has come to be regarded as an organ amenable to surgical procedure just as the other organs of the body. At the St. Louis City Hospital there have been five cases of cardiorrhaphy. Two of these cases, in 1901, were operated on by Dr. H. L. Nietert, who was among the first in America to suture the heart. At the same institution Dr. Louis Rassieur, in 1903, had a case of heart-suture with recovery, so that during my term of service opportunity was afforded of seeing and treating four cases. Of the five cases operated on, three made successful recoveries.

During the past two years I have operated on two cases of stab wound of the heart. The first case when received was in a critical condition and lived only four hours after the operation. The second case was admitted to the hospital under more favorable conditions and his recovery was uneventful. The case histories are as follows:

CASE I.—The patient, W. S., a white male, thirty-seven years of age, a roofer by occupation, entered the City Hospital, Feb-

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ruary 11, 1908, at 6.15 P.M., with the history of having been stabbed with a knife while fighting.

Immediate Condition.—When received in the emergency room it was evident that the patient was in a state of great shock. He was conscious, but drowsy and restless, and his face bore an anxious expression. He seemed to be suffering and frequently cried out with pain. The skin and mucous membranes were pale, and the body was cold and he was in profuse perspiration. He complained of great thirst. The pupils were widely dilated and reacted slowly. No abnormal nervous reflexes were noticed. While being undressed the bowel moved voluntarily. The urine upon catheterization was found to be clear, but contained a trace of albumin and hyaline casts. The patient bled from the nose and from wounds in the chest and buttock. He expectorated a bloody mucus. The pulse was irregular, soft and small, and the rate 86 per minute; respirations, 28 and regular; rectal temperature 99.8° F.

Examination of Wounds.—The patient had a contused and lacerated wound of the nose which was the probable cause of the epistaxis. On the left side of the chest, in the fifth interspace and one inch external to the mammary line, there was a penetrating wound of the chest, which wound when explored with the finger was found to take a direction toward the heart and apparently to involve this organ. In the sixth costal interspace and one and one-half inches external to the wound just described there was a second penetrating stab wound of the chest. These wounds were about half an inch in length and the tissue surrounding them was emphysematous. Blood escaped in large quantities from the pleural cavity through these wounds, and over the lower and posterior portion of the chest on the left side, the percussion note was flat. There was a third stab wound in the left gluteal region.

Diagnosis and Prognosis.—With the pronounced symptoms of shock and hemorrhage and the location and direction of the wound in the chest, the diagnosis of stab wound of the heart was simple. It was also evident that the pleural cavity had been involved and that a traumatic emphysema was developing rapidly. The great degree of shock and hemorrhage, combined with the nature of the wounds, made the prognosis extremely grave. The only hope for life lay in the immediate control of hemorrhage.

Operation.—As soon as the nature of the injury was ascertained, the patient was prepared for operation. He was wrapped in hot blankets and heat was applied to the extremities. Ether anæsthesia was preceded by a quarter of a grain of morphine. When the patient was well under the anæsthetic, the operation was started and the administration of ether discontinued.

An incision through the skin at the outer border of the cardiac area and internal to the left mammary line was made, extending across the fourth and fifth ribs. From either extremity of this incision two other skin incisions were made, directed toward the sternum. With costotome, the fourth and fifth ribs were severed and the intercostal tissues were readily divided with scissors. An osteoplastic flap was thus formed and by forcible traction the flap was reflected to the right, a hinge being formed near the sternal margin. This gave access to the cardiac region, but, inasmuch as the hemorrhage was profuse and ample room for quick work was needed, the sixth rib was also severed and retracted. The pleural cavity was almost completely filled with liquid blood and blood clots, and the heart was beating but moderately fast. There were two incised wounds in the pericardium, from which blood flowed very freely. The infiltration of blood into the pericardial and fatty tissue altered considerably the normal appearance of the cardiac area. The pericardial sac when opened contained mostly liquid blood. The heart was lifted from the sac, and near the apex of the left ventricle there was an incised wound, three-fourths of an inch long, which bled freely. When the heart was raised the left ventricle emptied itself through this opening and the heart stopped beating. As quickly as possible a silk suture was placed to close the opening. By compression and massage of the heart pulsations of the organ were re-established, but the heart beats now became considerably accelerated and were perhaps from one hundred and forty to one hundred and sixty per minute. This made suture of the wound very difficult. Interrupted silk sutures were used, care being taken not to include the endocardium. The heart was supported in the left hand. Mattress retention sutures were placed to relieve the direct tension on the suture line, and the spurting from the partially sutured wound was so forcible that it was necessary to use eight sutures to effectually close the wound. The heart was inspected and no other source of hemorrhage found. The pericardium having

been cleansed, the heart was replaced and the pericardial incision closed with catgut. The ends of two of the heart sutures were left long and were brought through the pericardium and tied. A small gauze drain was placed in the pericardium and dependent drainage of the pleural cavity was established by means of a rubber tube. The wound in the chest wall was closed with catgut for the subcutaneous structures and silkworm gut for the skin.

While the operation was in progress the patient had received hypodermoclysis of saline solution, and this seemed not only to increase the volume of the pulse, but also to improve the heart's action. It was noticed that the lungs were not completely collapsed and that they would expand and contract with the respiratory movements. While suture of the heart was in progress, the patient, who had practically received no anæsthetic during the operation, stated that he was thirsty, that he wanted a glass of water, and then asked for a can of beer. Before closure of the pericardium, the patient made efforts at coughing and the lung and heart were forcibly pushed into the wound in the chest. The operation was performed in sixty-five minutes. When the patient was put to bed his pulse was 118, of fair volume, and the respiration was 30 per minute.

He became very restless and morph. sulph. gr. 1/6 was given. An hour after the operation, the pulse was 96 and respiration 24; two hours later the pulse was imperceptible, respirations 28, shallow and short, and rectal temperature 100° F. The respirations became labored, and the patient died four hours after the operation, apparently from shock and hemorrhage.

At autopsy there was no blood in the pleural cavity or the pericardium. When the heart was carefully examined, a second and much smaller stab wound of the heart was found which had been overlooked at the time of operation. This wound opened into the left ventricle and was through the fatty tissues near the septum. The wound could not readily be detected, and it was all the more remarkable that, inasmuch as the cavity of the ventricle had been penetrated, there was no bleeding from this wound, indicating that muscular contraction was sufficient to prevent leakage. The cause of death was attributed to shock.

CASE II.—The patient, M. L., a white male, twenty-four years of age, engaged as a mechanic's helper, was admitted to the City Hospital August 22, 1909, at 12.40 A.M., with the history

of having been stabbed in the chest with a knife about a half-hour before entering the institution.

He was well developed and well nourished, weighing 164 pounds, and of medium height. The patient had suffered with pneumonia and occasionally had attacks of bronchitis, but he had mostly been in good health.

When examined in the emergency room he was slightly under the influence of intoxicants. He was conscious, restless, noisy and somewhat unruly. The skin was pale, the body was cold and in cold perspiration. The pulse was very feeble and irregular and the rate 96 per minute. At times the beats were strong and then again almost imperceptible. Judging from the character of the pulse, it was evident that the heart was laboring under difficulty.

Examination of the chest showed a stab wound parallel with the fifth intercostal space and two and one-fourth inches below the nipple, the outer extremity being in the mammary line, and the wound extending inward for three-fourths of an inch. The wound was clean-cut and no other injury was noticed. There was profuse hemorrhage from the wound and his clothing was saturated with blood. The chest was carefully cleansed, and the wound was examined with the finger. The wound took a direction inward and downward, and the finger, entering the pericardium, detected a wound in the heart. When the finger was removed from the wound, there was a gush of blood which showed that active communication existed between the pericardium and the external surface. There was but little escape of air from the wound and a pneumothorax did not seem to exist. The respirations, 24 per minute, were shallow but regular. After the escape of blood from the pericardium the character of the pulse improved markedly. The diagnosis of stab wound of the heart was made and arrangements were made for immediate operation.

Operation.—General ether anæsthesia preceded by morphine and atropine was administered. When the patient was thoroughly anæsthetized, an incision was made between the fifth and sixth ribs extending from the stab wound to the left sternal border. A second incision was made upward from the outer end of this wound, sufficiently long to include the fifth and fourth ribs. The finger as a guide was introduced into the stab wound, and the tissues in the fifth intercostal space divided toward the sternum. The pericardial and pleural attachments were separated with the

finger from the ribs, and with the costotome the fifth and fourth ribs were easily divided. The third incision was directed inward along the third interspace, thus making a quadrangular, osteoplastic flap with the hinge at the left sternal margin. There was no bleeding from the intercostal vessels and the internal mammary artery was not injured. The opening was sufficiently large for cardiac manipulation and the pleura was but slightly injured.

The incision in the pericardium was about two inches long and was enlarged upward and downward. The pericardial sac was freed from blood and blood clots, and the heart lifted forward for inspection. A wound one and three-fourths inch in length was found extending obliquely across the left ventricle, the lower end being about one inch from the apex. Blood escaped very freely from the left ventricle, but the bleeding was controlled by placing the finger in the wound. Small tenaculum forceps were inserted at the lower end of the wound and the heart was thus gently suspended. Its own weight produced sufficient traction to cause the edges of the wound to coapt and to control hemorrhage sufficiently for the placing of the sutures. Three, deep, interrupted sutures extending to the endocardium were placed and hemorrhage now only took place in spurts. Seven intermediate sutures were necessary to completely control the hemorrhage. The line of sutures was reinforced by two mattress stay sutures, the ends of which were left long. The heart was carefully examined for further injury, and none found. During the entire procedure, the heart's action was regular, and no undue manipulation was made. The pericardial sac was carefully cleansed, and the incision sutured with continuous catgut suture, leaving a small opening through which a gutta percha drain was placed. The long ends of the stay sutures were brought through the pericardium and were tied over it, hoping in this way to strengthen the wound in the heart. Fine chromicized catgut was the suture material used.

In the chest cavity old pleural adhesions were found, which not only prevented the lung from collapsing, but also made it difficult for the blood to enter the pleural cavity. Drainage of the cavity was, therefore, not indicated. The osteoplastic flap was put in position, and the bones approximated. The pleura and muscular structures were sutured with catgut and the skin with interrupted silkworm gut sutures. A small gutta percha

drain was placed in the stab wound. The anæsthetic was discontinued when the operation was started and was therefore reduced to the minimum amount. The operation was performed in forty-five minutes. When he was placed in bed, his pulse was weak but regular. His record was, pulse 132, respiration 22, rectal temperature 99.8 degrees F.

Postoperative Course.—On the day following the operation the temperature rose to 102.4 degrees F., respirations 42, and pulse rate 120. He was restless and small doses of morphine were given to quiet him. He explained that at the time of admission to the hospital he had a slight cough, and it became evident that a bronchopneumonia had developed in the left lung. The symptoms of pneumonia were present during the first week, but the patient complained of little distress. The drain in the wound had been removed on the second day, the wound itself practically healing by first intention. After the first week the patient felt well and comfortable. After the second week he was practically well, but was not allowed to leave the bed until the end of the third week. His temperature, pulse and respiration were normal.

Frequent auscultations of the cardiac area were made, but the heart sounds were always normal. There was also no evidence of pericarditis. Sphygmograms were made and in each case the tracings were normal. An examination of the skiagraph of the chest shows perfect apposition and union of the severed ribs.

The patient suffers no inconvenience or distress as a result of the operation. He has since been hunting and fishing, and in a recent communication states that he is strong and in good health (Fig. 1).

From a study of these cases and a review of the literature on the subject of surgery of the heart, one must be convinced that injuries to the heart can no longer be considered as invariably fatal, but that the heart may be manipulated and treated surgically just as any other organ of the body. In the treatment of these injuries it is well to bear in mind certain observations that have been made in regard to the nature of the wounds, the process of repair, the method of surgical attack, and the complications that may arise.

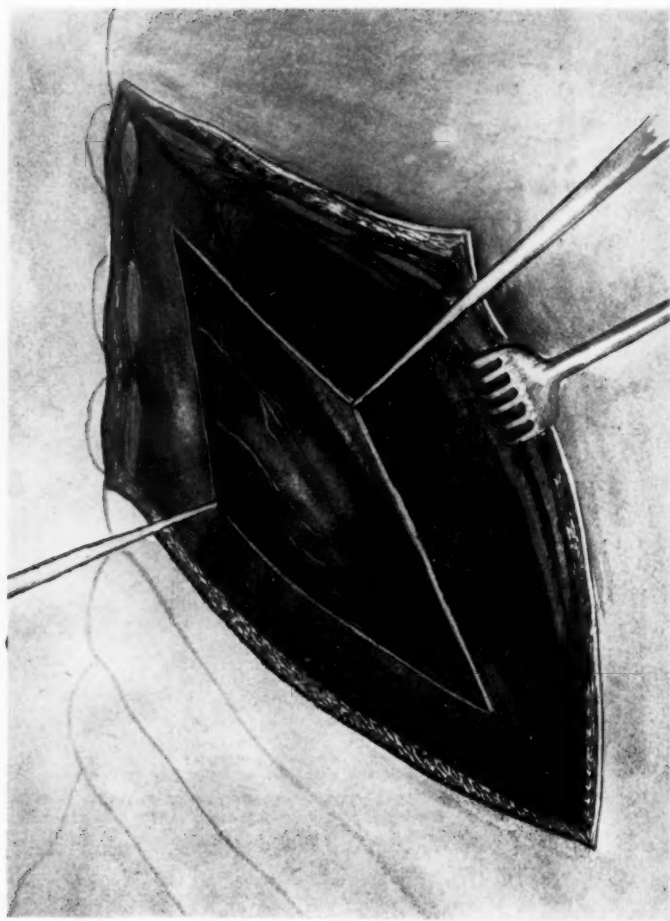
The principal injuries to which the heart has been subjected are those which resulted in puncture wounds, stab or incised

FIG. 1.



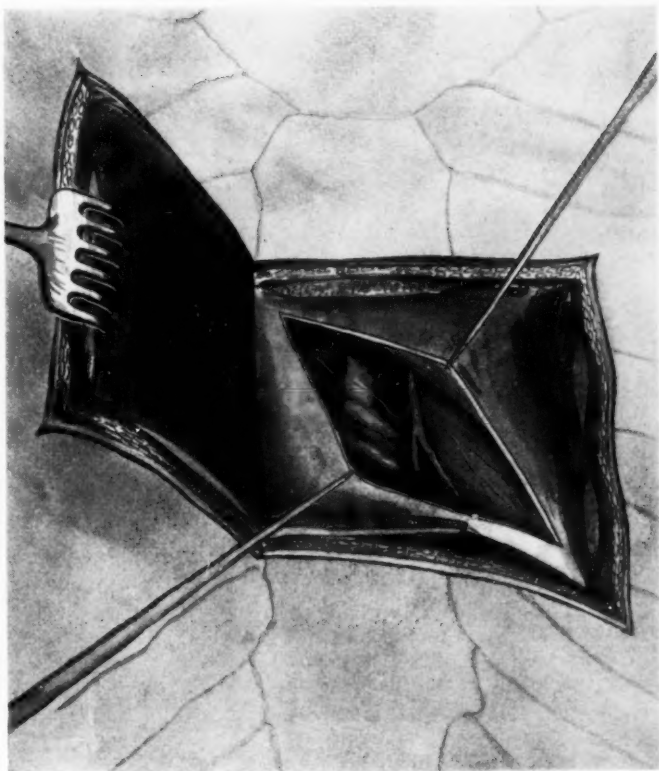
Case II. Penetrating stab wound of the left ventricle of the heart, with recovery of the patient. (Author's case.)

FIG. 2.



Osteoplastic flap made by modification of Spangaro's intercostal incision, giving complete access to the heart for operations on the ventricles. Pericardium opened

FIG. 3.



Sternal flap used in the interpleural route to expose the mediastinum, and of service in wounds of auricles and vessels at base of heart. Right auricle exposed.



wounds, gunshot wounds, or lacerated and contused wounds. Small wounds of the heart may prove fatal, but many heal without complication. Sudden death may result by injuries which involve the bundle of His, but the heart may without serious consequences be subjected to a greater degree of injury and manipulation than is usually supposed.

The great danger in injuries of the heart lies in the resulting hemorrhage which usually proves fatal. If the myocardium alone is involved, the bleeding may be profuse, but it is usually greater when the cavities of the heart have been invaded. Wounds of the auricles bleed more profusely than those of the ventricles, the tendency of the muscular contractures of the ventricles being to close the opening and thus to limit the hemorrhage. With certain incised wounds of the ventricles, where the cavities were penetrated, blood spurted from the wound only near the termination of the systolic contraction. The amount of hemorrhage depends upon the blood pressure, the size of the wound and the contractile force of the heart-muscle.

Small wounds of the heart, even if they involve the ventricles, may heal spontaneously. Healing of heart-wounds takes place by cicatrization and the better the approximation the stronger the wound. Investigators have demonstrated that when the wound is properly approximated a true myocardial regeneration takes place. In wounds that are weak or in wounds incompletely healed, aneurism of the heart and rupture are apt to occur, and it is therefore safer and better surgery to suture all serious wounds of the heart than to trust to spontaneous closure.

In wounds of the heart the pericardium often plays an interesting and important part. If the rent in the pericardium is large, the sac may distend but moderately with blood and blood clots, hemorrhage taking place either externally or into the pleural cavity. When the flow from the pericardial sac is impeded, the sac will become distended and hemopericardium results. Then the intrapericardial tension increases and heart tamponade results. The effect of this tension is felt first on the auricles, whose function is so

impaired that the ventricles receive an insufficient supply of blood for the needs of the system. The heart's action becomes irregular, labored and weak, and may cease entirely. The effect of heart tamponade can easily be detected by the pulse. When, after short duration, the blood or clot in the pericardial sac is removed the activity and rhythm of the heart is usually restored.

The symptoms of a wound in the heart are usually those of hemorrhage and shock. The patients are, as a rule, not conscious of the wound in the heart and suffer more from the effects of the injury. They are anæmic, restless, and anxious, and the body is cold and clammy. If they have lost much blood, they may be semiconscious and usually complain of thirst. The pupils may be widely dilated. The pulse may be weak, irregular or imperceptible. If heart tamponade is present, the volume, quality and rhythm will vary from time to time, giving one the impression that the heart is laboring under great difficulty. The respiration may at first be but little altered, but when the lung has been injured there is usually bloody expectoration. In stab wounds the diagnosis may frequently be made from the location of the wound and the character of the symptoms. However, in gunshot wounds the diagnosis may be more difficult. When the pleural cavity has been penetrated a pneumothorax results and the air will be forced through the wound. Emphysema of the chest wall may result, and sometimes a portion of the lung itself escapes through the opening in the chest. When the pericardial sac is but partly filled with blood, a splashing sound may sometimes be detected. The presence of blood in the pleural cavity may be detected by the usual signs of fluid in the chest. The diagnosis is confirmed by exploration of the wound with the sterilized finger or by exploratory pericardiotomy. The size of the external wound may be no index of the nature of the wound in the heart.

All wounds of the heart should be considered as serious, and death is due usually to shock and hemorrhage. When the peritoneal cavity has been invaded, and there is injury to abdominal viscera, the prognosis is extremely grave. In a

list of one hundred and sixty tabulated cases, Peck records a total of one hundred and two deaths and fifty-eight recoveries, a mortality of 63.7 per cent. It is to be hoped that with improved methods of technic and a more thorough understanding and appreciation of the nature of wounds of the heart the mortality rate may be materially reduced.

In the treatment of wounds of the heart we should carefully consider the patient's immediate condition (shock and the effect of hemorrhage), the nature of the operation, the sources of infection, and the remote results. Great stress should be placed on the treatment of shock, which in these injuries is usually accompanied by great hemorrhage. The patient should be wrapped in hot blankets, and if restless he should be given sedatives (morphin) in small doses, repeated if necessary. The nature and extent of the injury should be definitely ascertained by exploration of the wound with the finger. The sense of touch is essential in determining the location and extent of the injury, and the finger serves a better purpose than surgical instruments. In suspected injuries to the heart, it is safer and better to perform exploratory pericardiotomy than to run the risk of a fatal cardiac hemorrhage. It should be remembered that strict asepsis is essential in the treatment of these wounds, and frequently the fate of the individual is sealed by the one who first examines the case. The location of the wound in the heart (auricular or ventricular) should, if possible, be determined so that a definite plan of operation may be decided upon. If heart tamponade exists, the condition should be relieved at once, either by following up the wound into the pericardial sac with the finger and letting out the blood, or by pericardiotomy. With the exploring finger the border of the heart should be located and definite information as to pneumothorax should be ascertained. Direct exposure of the wound in the heart is of great value, and the opening in the chest should expose the heart sufficiently to permit of satisfactory manipulation if necessary. If the wound is mediastinal and the pleural cavity has not been involved, we should be careful to avoid these cavities in opening the chest. The tissues should be carefully

pushed from beneath the sternum and ribs with the finger, which should serve as a guide in outlining the flap. If the pleural cavity has been penetrated, less care is demanded inasmuch as a pneumothorax already exists. The nature and position of the wound thus often determines the location and character of the opening to be made in the chest. The pericardial opening should usually be enlarged to permit of easy manipulation and inspection of the heart. Stimulants and intravenous or subcutaneous injections of saline solution should not be given, as a rule, until methods of arresting hemorrhage are made possible. They are of special value when the loss of blood has been great. Time is an important factor in these cases and the operation should be done as promptly and quickly as possible.

In most cases the operation is complicated by pneumothorax and the respiratory function is greatly impaired. When the patient is unconscious the operation may be performed without an anæsthetic. If a general anæsthetic is to be used, ether will be found safer than chloroform, and usually but little anæsthesia should be used after the chest has been opened. Local anæsthesia is unsatisfactory and may be dispensed with. By the administration of morphine and atropine a few minutes before the anæsthetic is started, the amount of ether is materially reduced and the danger of post-anæsthetic pulmonary complication is lessened.

The cases are at times so desperate that while under observation or at operation the heart stops beating. When the heart has been arrested for a very short period and other signs of life have apparently disappeared, the heart has been encouraged to resume its contractions by gentle compression and massage of the organ. It seems also that the blood supply to the organ itself, as indicated by blood pressure, and the quality of the blood, are of great importance in maintaining and controlling the heart's action. Therefore, artificial respiration should always be combined with heart massage and efforts be made to raise the blood pressure.

At operation it occasionally happens when the heart is quickly lifted or manipulated that pulsation suddenly ceases.

This happened in Case I and seemed to indicate that reflex action was an important factor concerned with the heart's action. By gentle compression, however, the heart was encouraged to resume its pulsations. However, in many cases, the heart's action appears to be independent of the general nervous control and the heart seems to have the power and stimulus within itself to produce rhythmic contractions. In the treatment of these cases we should, therefore, not forget the value of heart massage as an aid in resuscitation.

The wound in the heart having been located, the method of approach through the chest wall must be determined, and for this purpose a variety of flaps have been used. A wound in the heart has been sutured through a wide intercostal space, but usually this is not possible. The flaps that have been mostly used open to the right or to the left, and are either entirely on the left side of the chest or extend across the sternum. The object should be to so construct the flap that easy access to the wound in the heart may be had with the least damage to the chest wall and the pleural cavities. The flap should be made with the finger in the wound as a guide, and this is especially necessary if the pleural cavities have not been invaded.

When the wounds involve the left pleural cavity, Spangaro's intercostal incision, with extension upward or downward along the margin of the sternum as seems necessary, is the one of choice (Fig. 2). This incision is made in the fifth or fourth left intercostal space. By retraction of the ribs a view of the pericardium and pleural cavity may be had. If further space is desired after double ligation of the internal mammary artery, the incision may be extended upward or downward and the cartilages divided with costotome near their sternal attachments. The pericardium may be easily incised and wounds of the right and left ventricles can readily be repaired. If still more space is desired for the suture of wounds of the auricles or vessels at the base of the heart, the sternum may be divided, best with costotome, after separation of the underlying tissues, and forcibly turned to the right, making a hinge along the right costal attachment.

Care must be taken not to enter the right pleural cavity, or else a fatal double pneumothorax may result.

If a mediastinal wound is present and neither pleural cavity has been invaded, a flap involving the sternum with hinge along the right costal attachment is preferred (Fig. 3). This flap is of service in operations at the base of the heart. The underlying structures must be carefully separated from the under-surface of the sternum and ribs, so that the pleuræ may not be injured.

A flap with hinge internal involving cartilages and ribs as used in Case II (Fig. 1), is of service in those cases in which there has been a pre-existing pleurisy and in which the lung is bound by adhesions. These adhesions prevent collapse of the lung in pneumothorax and should not be disturbed. This flap gives ample room for manipulation of the heart, but if more space is desired, the incision may be extended across the sternum with hinge at the right costal attachment.

In persons with narrow and long chests, the flaps may be somewhat atypical and in certain of these cases the heart is more centrally located. In these cases it may, therefore, be necessary to use flaps involving the sternum.

The hemorrhage from the wound in the heart is temporarily best controlled by placing the finger in the wound. In incised wounds if tenaculum forceps or traction suture be placed at one end of the wound and the heart be permitted to pulsate while thus suspended, the traction and muscular contractions tend to close the wound and limit the hemorrhage. It has been found that by this suspension it is easier to suture the heart wounds than if the heart were held in the hand. Interrupted silk or catgut sutures may be used. The sutures should be deeply placed, but not to include the endocardium. In large wounds there seems to be an advantage in fastening the pericardium over the wound, as this by adhesion strengthens the wound and may tend to prevent aneurism or rupture. Before closure of the pericardial sac, a careful search for multiple injuries should be made.

Inasmuch as many cases in which the heart has been sutured die from infection of the pericardium or pleural

cavity, the matter of drainage has received special consideration. That this infection may be unavoidable and introduced at the time of injury, there can be no doubt. It seems to be a wise plan to consider penetrating wounds as infected wounds and to promote drainage in these cases. Drains that do not drain are harmful, and often a gauze drain serves merely as a plug to enclose infection. Drainage can only well be accomplished when the external wound is kept open so that infectious material may be discharged through it. There must be an avenue of least resistance for the discharge of infection. If drainage is to be instituted, the external wound should be kept open. Rubber tissue as a drain will permit the discharge of infectious material and will not plug the opening. In my own experience, I have found it best to drain the dependent portion of the pleural cavity when infection was anticipated. The pleural cavity, especially if the lung is partially collapsed, does not well resist infection and therefore early drainage is desirable. It seems advisable not to completely close the pericardial sac, so that accumulations of fluid or infections may be discharged and not collected in the sac. It is a wise plan not to close the traumatic wound, but to leave it open for drainage. After all, the manner of drainage is governed largely by the results of personal experience.

In closing the wound catgut will be found best for the pericardium and muscular structures. It is safer not to close the skin wound too tightly, but to approximate the edges with interrupted sutures, leaving ample opportunity for drainage.

The chief postoperative complications are those associated with shock and hemorrhage, pneumothorax, pneumonia, and infection of the pericardium and pleura. Secondary hemorrhage occasionally takes place and may prove fatal. Embolism also occurs, but not as frequently as may be supposed.

If the loss of blood has been great and the hemorrhage has been controlled, the extremities should be bandaged to confine the circulation. Saline solution, intravenously, by hypodermoclysis, or proctoclysis should be given, or better, if possible, direct transfusion of blood. One should guard against anæmia of the brain, the effects of a lowered blood

pressure, and an over-distended heart. Diffusible heart stimulants are indicated, and the restlessness should be controlled by small doses of morphin. The urinary and intestinal tracts should also receive careful attention.

CONCLUSIONS.

The heart may be manipulated without serious injury to the organ and is amenable to surgical interference and procedure.

Hemopericardium with heart tamponade is a serious complication and demands prompt drainage of the pericardial sac.

In suspected injuries to the heart, the wound in the chest should be carefully explored so that the extent of the injury may be determined, and in cases of doubt, exploratory pericardiotomy is indicated.

Small wounds of the heart may heal spontaneously, but in all cases where hemorrhage from the heart exists, the wound should be promptly sutured.

In operations upon the heart when pulsations suddenly cease, massage of the heart and artificial respiration should be tried as aids in resuscitation.

With a minimum amount of anæsthetic the healthy lung is capable of performing its function, though to a less extent, even when the pleural cavity is exposed.

Time is an important factor in injuries to the heart, and an early diagnosis should always be made. The immediate treatment should be directed to the control of hemorrhage and shock. The chief remote complications result from infections of the pericardium and pleura.

In treating injuries to the heart, the surgeon should have in mind a definite plan of attack, and the kind of a flap to be used in approaching the heart should be determined by the nature of the wound in the chest.

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ABNORMAL POSITION OF THE DUODENUM.*

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THE duodenum is singularly constant in its relations, course, and length. Any exceptions are exceedingly rare and worthy of note. The anomaly that I wish to report was found in the person of a patient who was being operated upon for gastric ulcer.

The duodenum ran to the right and then turned downwards external to the hepatic flexure, ascending colon, and cæcum, and, merging into the jejunum, passed from without inwards below the cæcum into the small intestine area. The duodenum was completely surrounded by peritoneum. It had a long mesentery throughout, and could easily be held two or three inches in front of the abdominal wall. The head of the pancreas, closely applied to the duodenum, was visible and palpable between the layers of the duodenal mesentery, and readily followed the duodenum when the latter was brought outside the body.

Instead, therefore, of passing across the second lumbar vertebra and behind the transverse colon and superior mesenteric artery, it retained an early embryological position. There was, of course, no ligament of Treitz and no fossa duodenojejunalis. The condition is clearly one of arrested development. The cæcum in this case did not mount upwards to the lower hypochondrium, and did not pass in front of the loop of the duodenum. The cæcum did not descend to its usual final resting place in the right iliac fossa. It was high, completely surrounded by peritoneum, and very movable and could be brought out through the epigastric incision and held eight inches in front of the body.

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The patient, a lady fifty years of age, had suffered from indigestion for about eighteen months. Her symptoms consisted of pain that appeared three or four hours after eating. The mid-day and evening meals were generally vomited. She had lost thirty pounds in four months. She had never vomited long retained food nor blood. The stomach was considerably dilated, and the diagnosis was dilatation due to benign pyloric obstruction.

There was no ulcer about the duodenum or stomach antrum. One ulcer was visible and palpable on the anterior wall of the stomach midway between the lesser and greater curvature, over the lower part of the fundus. A crater-like ulcer on the posterior wall of the stomach was adherent to the transverse colon. The colon and stomach were separated. The bared surface of the colon was infolded. The stomach ulcer was excised and the wound closed. The ulcer on the anterior wall was also excised and the wound closed.

Recovery was uneventful. The patient has regained health and is now very well.

The normal changes in the position of the duodenum are very clearly described by Mr. Treves (now Sir Frederic Treves), in a paper which he published in the *British Medical Journal*, on August 28, 1885. "In its primitive condition the alimentary canal appears as a simple vertical tube, running down in the middle line, and connected to the spine by a simple vertical fold of peritoneum. In a little while, the upper part of the tube enlarges and becomes bulbous, and the rudimentary stomach is produced. The lower part of the tube retains its primitive connection with the spine, and retaining also very nearly its original vertical direction, becomes the descending colon and rectum, including a part also of the transverse colon. In fact, it persists as all that segment of the large intestine that is supplied by the inferior mesenteric artery. The intermediate part of the primary tube increases rapidly, and soon forms a large loop, which projects out of the still shallow abdominal cavity, and from which the intestine from the pylorus to about the middle of the transverse colon is ultimately developed. There is at first nothing to

indicate the separation of the large intestine from the small, but soon a bulging takes place at a point just behind the apex or middle of the loop, and this, in process of time, develops into the cæcum and its appendix. This large loop has a common mesentery, continued from the original vertical mesial fold of serous membrane that connected the primary intestinal tube with the spine. The loop has a narrow neck, formed above by the duodenum and below by that part of the large intestine that subsequently becomes the right extremity of the transverse colon. Between these two segments of gut, at the neck of the loop, the superior mesenteric artery runs to supply the bowel. As it runs in the mesentery, it gives off branches from its right or upper side to supply the small intestine, while from its left border arise the vessels for the cæcum and ascending colon. The intestine in the loop grows rapidly, and the mesentery increases in a corresponding ratio. That part of the membrane, however, that lies at the neck of the loop does not grow at the same rate. Thus it is, as Professor Flower has well pointed out, that the duodenum and the right end of the transverse colon never lose their primitive relation, in spite of the many subsequent changes that take place in the position and growth of the viscera. They continue to limit and bound the neck of the mesentery, and, as growth proceeds, this neck or root becomes proportionally narrower, while through it still runs the trunk of the superior mesenteric artery. In time, the great loop is withdrawn into the abdomen, and becomes twisted upon itself in a remarkable but definite manner. This twisting is due, in the main, to unequal growth in the two sections of the loop; for, while the small intestine has been increasing in length with great rapidity, the colon has comparatively grown but little. Just before the twist takes place, the cæcum will probably be lying about the umbilicus, and will be placed, together with the rest of the large intestine, wholly to the left of the middle line.

“When the change in position occurs, the cæcum mounts up towards the right hypochondrium; it passes in front of the loop of the duodenum, and ultimately descends to its

final resting place in the right iliac fossa. As a result of the twisting, the small intestines are turned towards the left side; what was originally the right side of the mesentery becomes the left side; and the vessels to the small intestine are seen to come off from the right border of the superior mesenteric artery, instead of from the right. The mesentery has been rotated, in fact, half a circle. At the narrow neck of the great loop the changes are less conspicuous. The right end of the transverse colon has passed in front of the duodenum; but they still form the boundaries of the narrow neck of the mesentery, and between them still passes the superior mesenteric artery. As development proceeds, the bowel grows somewhat out of proportion to the peritoneum about it, and this disproportionate growth is well marked in the two segments of bowel that form the neck of the great intestinal loop. As they grow, they become too large for these serous coverings, they to a great extent grow out of them, and thus it happens that the duodenum and transverse colon are brought nearer and nearer together, until at last their relations are very intimate, although their mutual positions have become modified. The development of the duodenum itself may now be considered. This part of the gut forms a loop of its own; a loop that starts from the pylorus, and ends where the gut becomes fixed by the musculus suspensorius. Its termination, therefore, is at the neck of the great general intestinal loop and close to the trunk of the superior mesenteric artery. The duodenum, which is at first comparatively of large size, has its own mesoduodenum, which is attached vertically to the middle line, being a part of the original mesial mesentery. When the pylorus moves to the right, the loop of the duodenum moves with it, so that the left layer of the mesoduodenum becomes anterior and the right layer posterior. When the twist takes place in the intestinal loop the duodenum has no share in it. The general position of the loop remains unchanged. The end of the duodenum is dragged across the middle line from the right side to the left, the superior mesenteric artery passes over it instead of by its side,

the dragging produced by the upward movement of the colon causes the terminal part of the duodenum to become vertical, and a sharp twist is formed in the gut where the duodenum and jejunum meet. The mesoduodenum and the mesentery are no longer continuous in the same plane. In time, the duodenum loses its mesenteric fold, partly because it grows out of proportion to the peritoneum and partly because developing viscera in the neighborhood draw the serous covering from it, and ultimately it actually acquires a large non-peritoneal surface."

END-TO-END INTESTINAL ANASTOMOSIS BY THE INVAGINATION METHOD.*

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ATTEMPTS to obtain end-to-end reunion of a severed intestine by invaginating one end into the other have been described since the earliest history of intestinal suture. Beginning with Jobert and Ramdohr all kinds of modifications have been practised; but it is fair to say that to-day intestinal reunion based on such a procedure does not occupy a definite place in the technic of intestinal surgery. The method which I venture to present has no pretension of competing with conventional methods; but it is believed that it is useful in certain difficult cases of reunion of the large intestine where other methods would ordinarily be impracticable or predestined to failure.

I first had occasion to employ it in a crude form in 1904; the report is briefly as follows:

CASE I.—Nellie W., 33, colored; operated on in St. Luke's Hospital December 19 for double pyosalpinx. The operation presented unusual difficulties, and at its termination it was seen that about six inches of the upper part of the rectum had been completely denuded of its peritoneum and its vitality obviously jeopardized. Ordinary resection being judged impracticable, the gut was divided at the lower end of the denudation. A long pedicle clamp was then passed through the anus and made to grasp the upper segment and pull it through the lower end down as far as it would go—nearly to the anus, where it was maintained by fixing the clamp in position. Two or three sutures were introduced at the point of contact of the two segments to ease the tension on the clamp. At that

* Read before the American Surgical Association, May 4, 1910.

time the idea that one could deliberately make a satisfactory suture which could be depended on alone did not occur to me.

To my astonishment the patient made an uninterrupted recovery. The clamp was removed in two days; fæces were passed normally *per anum*; there never was any leakage, as we could easily convince ourselves, the wound having been only partially closed as a precautionary measure.

In June, 1909, in the course of a panhysterectomy for fibroid uterus and a complex intraligamentous cyst, in order to make a clean enucleation I had to do deliberately what I had done inadvertently before—denude the rectum to a dangerous extent. This time I determined to make a careful and systematic reunion according to the technic to be described later.

CASE II.—Mrs. O., 26; operation in St. Luke's Hospital, June 10, 1909.

The denuded rectum was divided as described in Case I. About five inches of the denuded upper end were passed down into the cavity of the lower end, and approximation of the two portions at the neck was performed by some interrupted silk sutures completed by a superimposed continuous suture. The vagina was left open and gauze packing was placed in the cul-de-sac.

The patient made a good recovery; the suture was, however, not perfectly tight as for a few days there was some fecal soiling of the packing. Discharged July 11, well healed and having natural movements. Remains under observation and continues in excellent condition, particularly as regards the bowels, an obstinate constipation existing before operation having disappeared.

Encouraged by these results I decided on this procedure as the method of choice in two resections of the rectosigmoid junction for carcinoma.

CASE III.—Mrs. J., 53. Operation in St. Luke's Hospital, June 15, 1909. Extensive involvement of the sigmoid and a loop of small intestine by contact. Resection of sigmoid and

twelve inches of the ileum. Reunion of the colon as described in Case II. Patient succumbed three days later. Post-mortem examination of the wound showed no peritonitis or suspicion of fecal extravasation.

CASE IV.—Mrs. R., 49. Operation at St. Luke's Hospital, December 10, 1909, for intestinal obstruction of twelve days' standing. Median laparotomy disclosed a small annular carcinoma at rectosigmoid junction. Cæcal anus established by a small incision in the right linea semilunaris. Twelve days later resection of the carcinoma, end-to-end anastomosis by invagination. Successful result, but some infection of the abdominal wall by a minute leakage which persisted only twenty-four hours. The cæcal fistula closed spontaneously within a few days. Remains under observation, is in good health, and bowels move regularly.

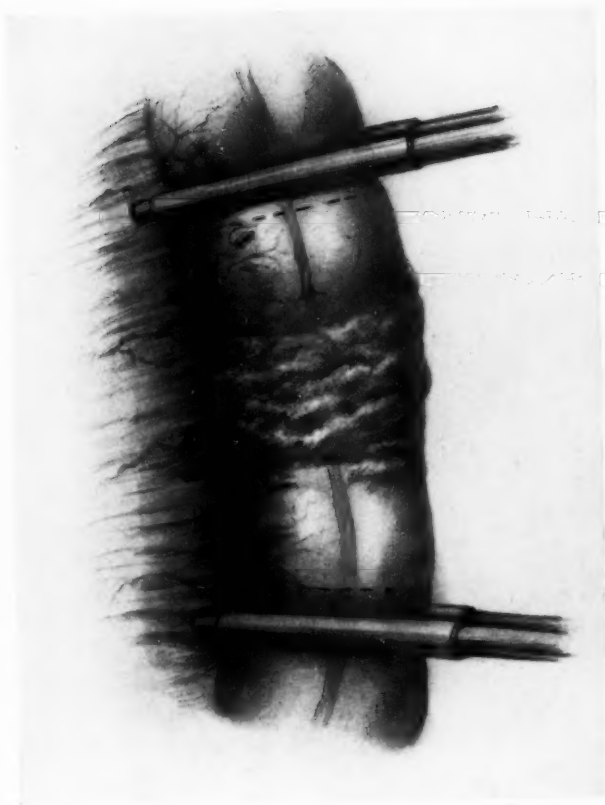
During the summer of 1909 Dr. H. K. Kellogg conducted some experiments for me on dogs, which gave us also the opportunity to investigate the possibility of using this anastomosis in the small intestine, and it was found to work well; but its usefulness is perhaps more evident in the large intestine, where end-to-end union is so apt to be imperfect even in the hands of the most competent. I believe that if lateral anastomosis is impossible after resection of the colon, the method here described will be found the next best. It has also an undoubted superiority over lateral anastomosis in its simplicity and requires much less time for its performance.

Technic.—The technic here described is based on the knowledge accumulated in the cases just described and the animal experiments performed in the Loomis Laboratory of the Cornell Medical College.

Usual preparation and incision of the abdominal wall at the most suitable point. Temporary occlusion of the gut by clamps.

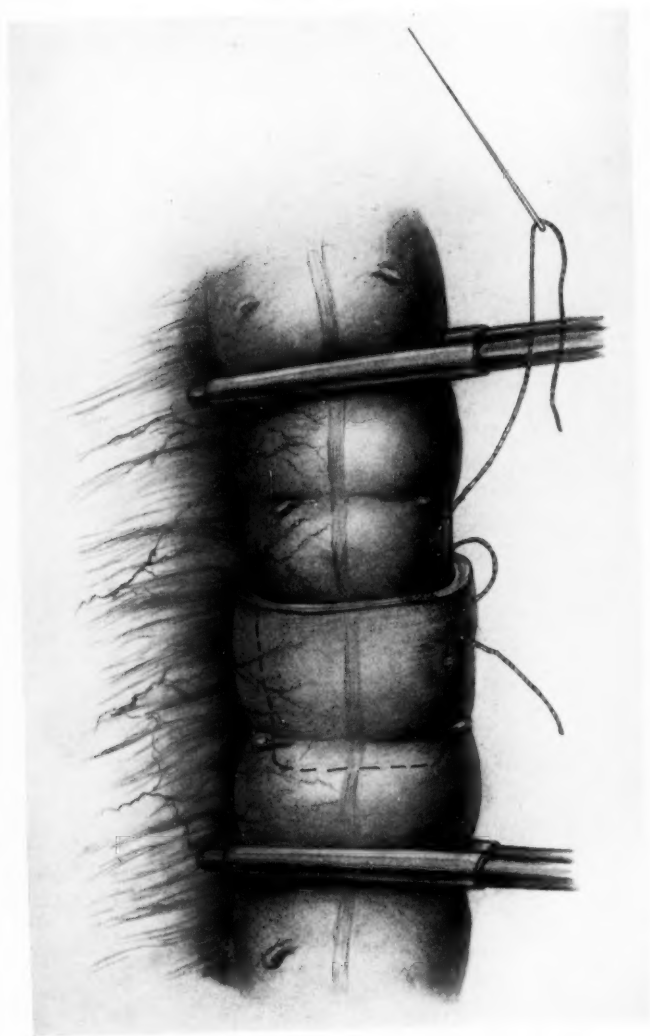
The upper cut edge of the gut is seized with two Kocher clamps and introduced by these into the lumen of the lower end and maintained there by an assistant. The extent to which it is feasible to accomplish this invagination will vary,

FIG. 1.



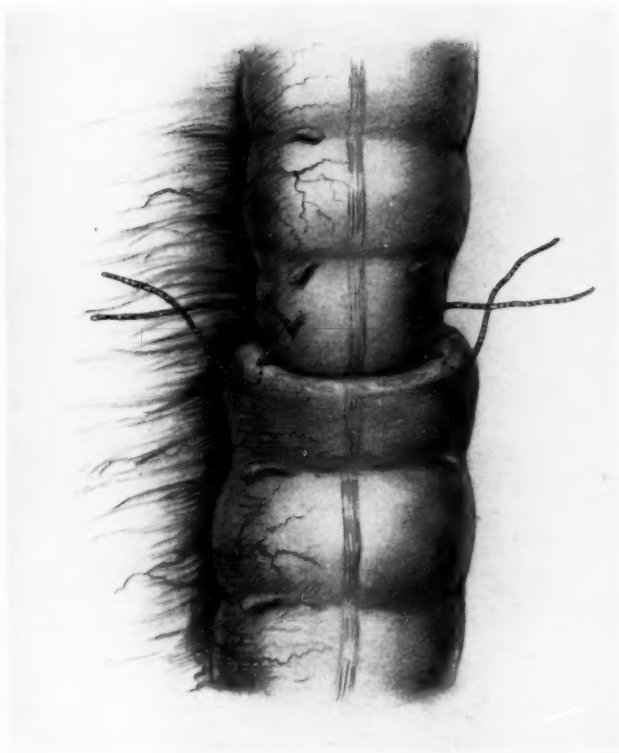
Preliminary clamping of intestine before its division.

FIG. 2.



Upper segment telescoped into lower. First suture introduced.

FIG. 3.



Shows invagination of edge of lower segment, burying the two peritoneal surfaces into contact.

FIG. 4.



Interior view of the invagination.

FIG. 6.



Interior view of the same specimen.

FIG. 5.



Resection of small intestine in a dog killed three weeks after operation. Shows absolutely no constriction.

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depending on the laxity of the mesentery. If the latter is very short, it may be elongated somewhat by a generous incision of its outer layer. As a general rule I should wish to carry the cut end of the upper segment so far down as possible, hoping more efficiently to direct the fecal current away from the suture line. The gut is rotated about a quarter circle so that the non-peritoneal covered surfaces do not entirely approximate in the circumference. Eight to twelve interrupted silk sutures are introduced thus. A Lembert suture is begun on the lower segment, the needle issuing just short of the cut edge; on the upper segment the needle is introduced just above the line where the cut edge of the lower segment lies against the intact wall of the upper. When the knot is tied the free cut edge has been turned inward and only the peritoneal surfaces are in contact. A continuous running suture is applied over this area, further invaginating the first ones, the Kocher clamps being previously withdrawn.

In the after treatment the bowels are not moved for three days and only a low residue diet is given.

Finally, I desire to call attention to the specimen of the resection of the small intestine in a dog. There is no narrowing of the canal, and this fact dismisses any theoretical arguments that might be raised. In the large intestine such a degree of stenosis, if any, is insignificant.

Since this paper was written, the procedure has been employed in two cases of gangrenous femoral hernia. One recovered fully, but the other died, peritonitis developing on the fifth day.

TRANSACTIONS

OF THE

AMERICAN SURGICAL ASSOCIATION.

Meeting held in Washington, D. C., May 3, 4 and 5, 1910.

OPERATIVE TREATMENT OF TUMORS OF THE HYPOPHYSIS.

DR. A. E. HALSTEAD, of Chicago, Ill., said that a survey of the literature on the operative treatment of tumors of the hypophysis discloses the fact that many of the procedures proposed are based not on clinical experience, but on observations made in the post-mortem room; therefore, the merits of these methods are still unproved. Halstead proposes what he terms the oronasal route, which he employed successfully in one case. It is a modification of the infranasal method of approach, but is without the trauma and disfiguration which must follow the Koenig operation.

He presented a man, showing the extremely good result obtained by this method of procedure. He also reported a fatal case.

OPERATIONS ON THE HYPOPHYSIS.

PROF. VON EISELSBERG, of Vienna, read a paper on Operations on the Hypophysis, for which see page 1.

DR. SAMUEL J. MIXTER, of Boston, followed with critical remarks and the report of a case, for which see page 15.

DR. HARVEY CUSHING, of Baltimore, said that the various means of approach to the hypophysis do not make so much difference as does the matter of dealing with the structure when it is brought into view. The growth often becomes malignant, as is true of long-standing trouble with the thyroid, and it is conceivable that it cannot be entirely removed. In fatal cases it has often been found that only a mere fragment of the growth has been taken away. The operation in the first place has for its object the relief of pressure; these symptoms can be combated by the mere removal of the lower part of the sella turcica and the splitting of the capsule of the gland. Whether many of

these adenomas are merely hypertrophies of the gland comparable to various diseased changes in the thyroid we do not know, but if so partial removal is indicated.

DR. A. B. KANAVAL, of Chicago, remarked, concerning the technical procedure in Dr. Halstead's cases, in the first one particularly, that the view could not have been better. The operation was very quickly done, the anterior wall of the sphenoidal sinus quickly removed, and the bulging sella turcica opened, and a tumor protruding into the sinus was removed without difficulty. In the second case the sella turcica did not bulge into the sinus, it was seen with more difficulty, and was arrived at by anatomical deductions. In both cases there was considerable hemorrhage and he would suggest the elevation of the head during the operation. In the majority of cases it will only be necessary within the nose to remove the vomer and the anterior portion of the sphenoid in order to reach the sella turcica.

DR. DEAN LEWIS, of Chicago, said that the tissue removed from the first case contained no elements which are ordinarily found in the anterior lobe or the pars intermedia. The tumor was composed of stratified epithelium with a papillary arrangement. The lower cells rest upon the stroma of the papillæ and are cylindrical, while the cells of the succeeding layers differ in shape; the difference apparently being due to variations in pressure. As the cells of the anterior lobe and the pars intermedia are not reproduced in this growth, we must assume that the tumor has probably developed from an epithelial inclusion, which has not gone on to complete differentiation. The growth corresponds histologically to a group of tumors which occur about the infundibulum and extend down to the sella and up to the third ventricle.

The tissue removed from the second case came from the anterior lobe. In some sections the cell columns are cut parallel, long rows of cells resting between rather thick connective-tissue trabeculæ. In other fields the cell columns are larger than normal; the connective tissue between the different columns having broken down, thus permitting of fusion. In still other fields the fusion has become so marked that large groups of cells are found, hyperplasia apparently having ended in adenoma formation. Karyokinetic figures may be seen in a number of different fields.

It is important to recognize the complex structure of the

hypophysis in making the anatomic diagnosis of tumors of this gland, and to remember that the cells of the anterior lobe, when growing rapidly, tend to reproduce the structure of a sarcoma. Stains which differentiate granules should therefore be used in the study of all growths apparently originating in the hypophysis.

BENIGN BONE CYSTS, OTITIS FIBROSA, GIANT-CELL SARCOMA, AND BONE ANEURISM OF THE LONG PIPE BONES. A CLINICAL AND PATHOLOGICAL STUDY WITH THE CONCLUSION THAT CONSERVATIVE TREATMENT IS JUSTIFIABLE.

DR. JOSEPH C. BLOODGOOD, of Baltimore, read this paper.

DR. RUDOLPH MATAS, of New Orleans, related the history of a case in which after removal of a giant-cell sarcoma from the humerus there was such a large cavity that he used about an ounce and a half of Mosetig cement to fill it, and the patient later developed extreme symptoms of iodoform poisoning, as was but natural from the large amount of the cement used. In ten days, however, he recovered from its effects and the arm healed with a perfect contour of the bone. Beck's paste promises to be a most valuable means of filling up bone cavities.

DR. WILLIAM L. RODMAN, of Philadelphia, recalled a case operated upon in 1889 for large giant-cell sarcoma of the lower jaw by free chiselling and curettement but without removal of the maxilla. The patient lived for more than ten years after this operation, and may be alive to-day.

DR. JOSEPH A. BLAKE, of New York, had a case of sarcoma of the bone, the fourth finger of the patient being diseased. A simple operation in this case proved most satisfactory, and now, three years since operation, there is a normal phalanx.

DR. HARRY M. SHERMAN, of San Francisco, said that in his experience salt solution poured into these cavities a little in excess just before the last stitches are taken is as good as any other material for filling; it is replaced by blood, and obviates the necessity of putting in any foreign body such as iodoform or bismuth.

DR. DUDLEY P. ALLEN, of Cleveland, said that some years ago he removed the lower jaw of a patient for giant-cell sarcoma, leaving but a small portion of the substance of the jaw. He used a splint to hold the teeth in place. The patient recovered entirely and is now well.

DR. WILLIAM S. HALSTED, of Baltimore, was reminded of a

patient with a myxoma of the humerus; although the disease involved the bone from one end to the other there was no cyst and no fibrous tissue. The bone was excised excepting for a strip posteriorly and at the lower end, and the entire cavity carefully swabbed out with carbolic acid. The patient made a good recovery and had a strong humerus, but there were implantation recurrences in the soft parts on two occasions. It has now been four years since the first operation and the patient at present is perfectly well.

DR. NATHAN JACOBSON, of Syracuse, in reference to giant-cell sarcoma of the jaw, recalled one case still living in whom he did a partial excision of the upper jaw for giant-cell sarcoma about 25 years ago. There was never any recurrence. In his experience, in those cases of giant-cell sarcoma where there is reasonable cleaning out there is seldom a recurrence of the growth.

PROFESSOR A. VON EISELSBERG, of Vienna, said that in such cases as these mentioned by the reader of this paper he was in the habit, before finishing the operation, of pouring boiling water into the wound in order to destroy all the germs, and had found it a most satisfactory method.

DR. JOSEPH C. BLOODGOOD, of Baltimore, in closing said that Dr. Halsted's case of exostosis with involvement of the humerus brings out the point that pure myxoma is a benign tumor, that recurrence after operation may be due not so much to leaving a portion of the tumor growth behind as to infecting the wound in removal of the tumor. In such cases it would be well to use boiling water, pure carbolic, or Paquelin's cautery to disinfect the wound.

REMOVAL OF A TACK FROM THE LEFT BRONCHUS.

DR. N. B. CARSON, of St. Louis, Mo., reported the history of a child, aged 4 years, who was brought to his service in the St. Louis Mullanphy Hospital, January 18, 1909. A month before entering the hospital she was supposed to have swallowed an upholsterer's tack, which was followed by a severe spell of coughing and later by a very serious illness. Physical examination showed the child to be very pale, anæmic, emaciated, and weak. She swallowed either liquids or solids with difficulty, and coughed almost constantly, with an expectoration of white mucus, and the coughing was accompanied by a very severe pain on the left

side of the sternum. The left lung was dull in the middle portion, while the upper and lower portions were more or less resonant.

A skiagraph of the chest showed the tack in the median line with the head down and the point upwards, the point being lodged in front of the body of the fifth dorsal vertebra. Examination of the sputum was negative, as was also Von Pirquet's test.

On January 27 tracheotomy was done, and an attempt made by means of the bronchoscope to remove the tack, which failed. On January 29 a skiagraph located the tack about the beginning of the left bronchus. January 30, under rectal anæsthesia, a section of about an inch of the seventh rib on the posterior line was removed, and an opening made into a small abscess cavity in the lung, which discharged about an ounce of yellowish pus. At the same time the bronchoscope was reintroduced into the tracheal opening, and the left bronchus was found to be entirely closed. On account of the inability to get permission to operate sooner nothing was done until July 27, when an opening was made in the chest over the sixth rib and about three inches of the rib removed and the pleural cavity opened. The lung was entirely solidified, and upon exploring the left bronchus at its entrance into the base of the lung an abscess cavity was located, which when opened discharged about a drachm of fetid pus. The tack was found in this abscess cavity and removed.

At 7.30 of the same evening there was a twitching of the left side of the face, arm, and hand, which was followed by a partial hemiplegia. After this the patient improved steadily until the evening of August 2, when there was a gush of blood from the nose and mouth which was speedily followed by death. Post-mortem showed that there had been an extensive inflammation involving the entire lung and the pleura of that side. Between the left bronchus and the pulmonary artery was an abscess cavity in which the tack had been lodged after it had forced its way through the bronchus. A small opening was found in the pulmonary artery as a result of the erosion caused by the head of the tack.

SURGICAL TREATMENT OF ŒSOPHAGEAL DIVERTICULA.

DR. CHAS. H. MAYO read a paper with the above title, for which see page 812, June, 1910.

DR. SAMUEL J. MIXTER, of Boston, said that he had operated upon three cases of œsophageal diverticula. Where operation is

not done, it may be possible in some cases by the passage of very large bougies or probangs by means of a string guide to secure a sufficient dilatation of the spur to allow the passage of food sufficient to keep the patient alive. He had about half a dozen such cases.

DR. GEORGE W. CRILE, of Cleveland, reported that he had operated upon two cases of œsophageal diverticula, both of which recovered.

DR. JOHN B. MURPHY, of Chicago, said that the enucleation of the sacs of diverticula is not a difficult matter in itself, but it leaves a large cavity, and it is difficult to avoid the danger occurring from leakage at the suture, infection from the mouth, and particularly the action of the salivary glands upon the loose connective tissue of the mediastinum. He thought not opening the sac at all is the only safe procedure.

DR. GEORGE E. BREWER, of New York, called attention to one symptom in œsophageal diverticula which is characteristic, that is the presence frequently during the day, perhaps every hour or half hour, of an accumulation of thick, tenacious mucus which the patient will regurgitate to get relief. His own experience had been limited to three cases and one operation. This patient was a woman 80 years of age who had lost 50 pounds through starvation. She made a perfectly good recovery from the operation.

DR. DEFOREST WILLARD, of Philadelphia, remarked that surgeons should always remember the possibility of enlarged thymus in sudden deaths in young infants under ether. In such cases one is very likely to be misled by the statement that the child has swallowed some foreign body.

DR. WILLIAM L. RODMAN, of Philadelphia, believed that in cases of foreign bodies in the air-passages great risk is incurred in delaying the period of operation, and urged that all such cases be operated upon immediately upon being seen.

DR. NATHAN JACOBSON, of Syracuse, referred to a case of a 15 months' old child who swallowed a bean. By a tracheotomy the bean was gradually removed and the child made a good recovery. Regarding misleading histories, he was called to see a child suffering from complete obstruction of the trachea, supposed to be due to having swallowed a piece of bone. Subsequent history showed, however, that the child had inherited syphilis, and evidently had had gradually increasing disturbance,

and the history of the swallowing of the foreign body was purely an assumption.

DR. ALBERT VANDERVEER, of Albany, mentioned two cases bearing upon the subject of œsophageal diverticula, one in a physician who refused to have any instrument passed and who subsequently died of an acute pneumonia; the other occurring in a woman about 50 years of age. In this case it was impossible to get into the stomach with any form of instrument and he therefore did a gastrostomy and the patient made a good recovery. She now alternates between tube feeding and the natural method.

DR. JOSEPH RANSOHOFF, of Cincinnati, said that he had treated a case of abscess of the lung which lived four or five weeks after operation. The abscess was the result of the inhalation of a peanut shell.

He mentioned also a case of a foreign body in the air-passages which was unsuspected. Some two or three months after doing an intubation for laryngeal croup in a little child, the patient expectorated a small triangular tag such as is used to stiffen the corners of pasteboard boxes; the presence of this foreign body had not been suspected at the time of operation.

TESTS TO DETERMINE THE EFFICIENCY OF THE COLLATERAL CIRCULATION BEFORE ATTEMPTING THE PERMANENT OCCLUSION OF THE GREAT SURGICAL ARTERIES.

DR. RUDOLPH MATAS, of New Orleans, La., made an address on this subject, in the course of which he said:

The surgery of the vascular system bristles with problems which still await solution, but of these none is more important or fundamental than the study of the collateral circulation with the view of determining its efficiency in preserving the life of the peripheral parts before permanently obstructing the more important arterial channels of the circulation.

The knowledge of the efficiency of the collateral circulation is of special importance before undertaking the surgical treatment of the peripheral aneurisms or the removal of tumors which include the large vascular trunks of the regions involved, *i.e.*, thigh, popliteal space, upper arm, neck. The speaker reviewed a number of suggestions and methods by which the condition of the circulation in the peripheral parts, after the temporary occlusion of the main trunks, could be tested; but of these none

appeared to him more simple and satisfactory than a modification of the Moszkowicz test which he had devised and applied with much success in his practice.

If a popliteal aneurism be taken as an example of one of the more frequent types of aneurisms in which a knowledge of the peripheral circulation is desired, the author would apply his test as follows: The patient is placed in the recumbent position and the affected limb is exposed on a white sheet which will show the variations in the color of the skin to the best advantage. The operator should begin by determining the position of the femoral artery in Hunter's canal, as near the aneurism as possible, and then adjust the block of a mechanical compressor which is to rest upon the artery without compressing an area larger than is strictly necessary to obliterate the pulse in the aneurism and the pulse in the peripheral arteries (dorsalis pedis and posterior tibial). The best instrument for this purpose is the Massachusetts General Hospital compressor, designed originally (thirty years ago) as a substitute for digital compression. This instrument has now become obsolete, but for the purpose of this test it is most useful and satisfactory. After adjusting the block of the compressor upon the artery at a point nearest the aneurism, the circulation in the limb outside of the small area of localized compression should not be interfered with. Having determined the position of the vessel, the compressor should be tightened on the artery until the aneurism is "stilled" and all peripheral pulsations cease. When this is done, some significant changes in the appearance of the foot, toes, and peripheral parts will be noticed, but the test of the collaterals will really depend upon the appearance or absence of the "*hyperæmic blush*" which is obtained by a complete preliminary ischæmia of the limb. This is done by applying an Esmarch elastic bandage from the toes to the highest level of the aneurism, while the circulation in the sac is absolutely controlled by compression of the main artery on the central or cardiac side of the aneurism. With the finger of the operator constantly on the aneurism to make sure that its pulsation is absolutely controlled, the elastic bandage is held in place for five or six minutes in old subjects, and ten in the younger patients (less risk of injury to the arteries, thrombus, embolus, etc.).

The elastic bandage is now quickly removed, while the compressor still secures the main artery. Close attention must now

be given to the returning wave of hyperæmia, and the presence of the blush is noted as it descends rapidly at first to the zone below the level of the compressor, and then gradually, as it spreads down to the leg, ankle, and toes.

The author has applied this test several times and has conclusively proved that the hyperæmic blush after elastic constriction will descend and spread over the entire limb, in spite of the occlusion of the main trunk, *provided the collateral circulation is efficient*. The hyperæmic wave will not descend and spread over the peripheral parts if the collateral circulation is inefficient.

Contrary to the teachings of Moszkowicz, the author is convinced, by his personal observations, that the hyperæmic blush is not arrested on a level with the line of obstruction or obliteration of the main trunk, but will always spread beyond it to the peripheral parts as long as the collaterals are efficient and pervious. The hyperæmic test is a test of the existence of a capillary circulation in the peripheral parts, regardless of the fate of the main trunk.

There are great variations in the time that may be required for the appearance and the spread of the blush over the extreme periphery; but when it does appear, the operator may rest assured of the vitality in all the "pink parts."

The clinical applications of this test, as well as its interpretation as a circulatory phenomenon, were discussed by the author.

In a second division of his address, the speaker discussed the mode of testing the efficiency of the collateral circulation of the brain and in the arterial trunks at the roots of limbs, where no direct compression of the main artery on the cardiac side is possible, and where the hyperæmic test is not available. In these regions, especially in the neck, he advocated the preliminary occlusion of the main artery with removable aluminum bands, which occlude the artery without injuring its walls. If any evidence of peripheral disturbance should occur, either in the brain or peripheral parts, the band could be removed. He had demonstrated by experiments performed on dogs, with the assistance of Dr. Allen, that the bands could be allowed to remain on the vessel fully seventy-two hours without permanent injury; so that within this time the bands could be removed and the circulation restored.

The following are the conclusions arrived at: 1. It is possible to compress a vessel to the point of obliterating the pulse and

maintain this pressure for a period of from three to four days, before adhesive or obliterative changes in the intima occur. 2. All the vessels clamped in this manner stood compression seventy-two hours without apparent microscopic changes in the intima; some few began to show marked changes in ninety-six hours. 3. There is apparently no reason why in occluding the great vessels at the root of the neck, chest, and lower abdomen, in continuity, these removable bands should not be substituted for the circular ligature, which permanently damages the artery, even when carefully applied. Furthermore, the ligature does not permit of the release of the constriction after a few hours or days of observation, without certainty of thrombus formation at the seat of the ligation. 4. In view of the preceding statements, it would seem logical to utilize the simple method of occlusion as a preliminary test of the efficiency of the collateral circulation in all regions in which the hyperæmia test as previously described is not applicable. A brief statement of this research was presented at the meeting of the Society of Clinical Surgery last November at Rochester, Minn. Since then more experimental and clinical work has been done, and a careful histologic study of the specimens removed has also been conducted with the assistance of Dr. Gurd of the Laboratory of Surgical Pathology of Tulane University. It is the intention of the author to submit a joint paper with his assistant, Dr. Allen, at the next meeting of the American Medical Association in St. Louis, in which a full account of the work thus far done will be presented.

DR. WILLIAM S. HALSTED, of Baltimore, reported an operation for a large tumor of the popliteal space which necessitated the excision of practically the entire popliteal artery, vein, and nerve, and in which was used Carrel's method of vessel transplantation. The circulation in the limb was not interfered with at all or very little, and there were no evidences of interference with the general circulation, but this could not be attributed to the transplantation of the vein, which became thrombosed in the lower part. With reference to partial occlusion of arteries in the cure of aneurism, they had had two cases, one in which a subclavian aneurism was practically cured for a year, and one of enormous iliofemoral aneurism in which the band cut off the pulse but did not altogether interrupt the circulation in the artery below. Occlusion of the common iliac artery in from 25 to 33 per cent. results in gangrene of the limb, but so far as he knew

there was no reported case of gangrene from aseptic ligation of the common carotid artery.

DR. CHARLES H. MAYO, of Rochester, Minn., mentioned the case of a patient who came to him after the common carotid on one side had been ligated for arteriovenous aneurism. In this operation an attempt was made to ligate the veins around the orbit, resulting in the loss of the eye. When the patient came to him there was an enormous protrusion of the left eye, and pulsating veins on that side of the head. He determined to occlude the common carotid, which he proceeded to do under cocaine anæsthesia, using a little clip of tin about three-quarters of an inch long and the width of the artery. When almost through with the operation the patient remarked that she could not see anything; he immediately began to loosen the clip until her vision returned. That was done six months ago and last week the clip was still on her common carotid, and her vision was better than before operation.

DR. JOSEPH RANSOHOFF, of Cincinnati, was of opinion that if there is an opportunity for circulation to be thoroughly established there is no danger from the tying of the common carotid.

DR. ALEXANDER PRIMROSE, of Toronto, had found that the tying of the common carotid is safe in most young subjects but dangerous in old people.

DR. MATAS remarked in closing that in his tests he had determined that the artery or vein retains its integrity, and the circulation can be restored if the band is removed within seventy-two hours.

END-TO-END INTESTINAL ANASTOMOSIS BY THE INVAGINATION METHOD.

DR. C. L. GIBSON, of New York, read this paper, for which see page 116.

DR. CHARLES H. MAYO, of Rochester, Minn., said that the invagination method of intestinal anastomosis was valuable in the removal of tumors low in the sigmoid; at the upper rectum, about the only way to get a union is to invaginate the upper end into the lower.

DR. JOHN B. DEAVER, of Philadelphia, reported the following cases in this regard: In the early part of last winter an artificial anus caused by ulcerative separation of the lower sigmoid at junction with rectum, due to pressure necrosis consequent upon

the presence of an old appendiceal abscess evacuated through the linea alba some weeks previously. Spencer Wells forceps passed up rectum, and sigmoid brought down to anus and stitched to freshened margin of anus. Patient made a good recovery. The second case occurred three weeks ago, being one in which the lower sigmoid was damaged in removal, by panhysterectomy, of a uterine tumor involving the bowel. Patient recovered.

POSTOPERATIVE INTESTINAL OBSTRUCTION.

DR. GEORGE WOOLSEY, of New York, read a paper with this title, which, in abstract, is as follows:

Importance of Subject.—Common occurrence by reason of frequency of abdominal operations, in spite of improved technic. Frequency of septic or paralytic cases much reduced by improved technic. Fifty cases collected in past five years in the Presbyterian Hospital, only six of these paralytic obstruction, nine due to strangulation, two to volvulus, and most of the remainder to angulation. Nine of these in his service (mortality 12.5 per cent. in eight operations). An equal number in practice elsewhere.

Classification.—Early and late (Broca), mechanical and dynamic (Mikulicz). Mechanical ileus comprises strangulation and obturation. Dynamic, or better paralytic, obstruction most often due to sepsis, some cases due to postoperative atony, others to disturbance of innervation.

Etiology.—Two great factors, septic and mechanical.

A. *Mechanical.*—(a) Strangulation usually due to band or volvulus, or both. When blood supply cut off paralysis of gut is added. (b) Obturation commonly depends on angulation. Distended proximal arms of loop presses on distal arm and closes it like a trap, the adhesion of the end of the loop preventing it from being straightened out by peristalsis. Adhesions most often in or near pelvis. Most adhesions disappear in time. Factors determining obstruction by adhesions: (a) adhesions of gut in an abnormal position; (b) idiosyncrasy to the formation of many and firm adhesions. Other causes of mechanical obstruction: (a) secondary abscess, causing pressure and usually a valve-like closure, as in cases of adhesions; (b) Trendelenburg position; (c) pressure of root of mesentery on duodenum, causing arteriomesenteric ileus or acute dilatation of the stomach.

B. *Paralytic Obstruction.*—A similar result (paralysis) due

to (a) sepsis, the most common cause, (b) handling of intestine causing atony, or (c) to trauma of nerve supply, as in extra-peritoneal operations, etc. Sepsis probably acts mostly by a reflex paralysis on Auerbach's plexus. Peristalsis may be reflexly inhibited through splanchnic nerves (Cannon and Murphy). Overdistention may arise from the atony due to handling or traumatism of nerves or plexus. Overdistention may cause obstruction by causing (a) paralysis, (b) angulation, (c) volvulus.

Obstruction most often follows appendicitis or appendectomy (32 in 50), next most often pelvic conditions (13 in 50), especially ovarian cysts. Mortality of the 50 cases (48 operations), 37.2 per cent.

Pathology of Fatal Result.—Death due to bacteriæmia in septic peritonitis. Where no peritonitis, death attributed to autointoxication (neurin, putrescin, etc.). Braun denies this and claims terminal sinking of blood-pressure due to basal anæmia from great blood stasis in splanchnic area, and that drainage of bowel favors cure by relieving congestion in splanchnic area, not by avoiding autointoxication. Several experiments confirm this.

Diagnosis easy from symptoms in late cases. If morphine has to be repeated for pain, operate for obstruction. In many cases we can distinguish between strangulation and obturation by "peritoneal shock," intensity of onset, and symptoms. In some cases we can locate position of obstruction by position of early pain, distention, exaggerated peristalsis, character and onset of vomiting, Von Wahl's sign, etc.

In *early* cases diagnosis not so easy, obscured by peritonitis, operative trauma, sequelæ of anæsthesia. Where peritonitis was or is present must distinguish between it and obstruction. Many of the symptoms identical. Diagnostic symptoms given. Rigidity the important sign of peritonitis, absolute constipation of obstruction. If latter cannot be relieved, diagnose obstruction. Some early causes of mechanical origin. Important but difficult to distinguish them. Presence or absence of pain, peristalsis, distention, and other signs help to determine question. Possibility of acute dilatation of stomach (symptoms enumerated), and of obstruction with many symptoms lacking must be remembered.

Treatment.—A. Prophylaxis, great importance and success of it. Problem is to prevent sepsis, operative trauma, and adhesions, to which nearly all cases are due. Hence operate all cases

of appendicitis as soon as diagnosis is made. When septic peritonitis present, modern technic (Murphy's) will cure most cases and prevent paralytic ileus. Opposite plan advocated by some, *i.e.*, excitation of peristalsis to distribute germs, increase hyperæmia of peritoneum, and thereby the autolysis and resorption of the pus. Physostigmine or atropine used by some before and after operation. The real field for this is in postoperative atony. To prevent the atony avoid rough and undue handling of intestines. When early distention is marked and increasing, gain early action of bowels by enemata of various kinds, with or without physostigmine. Stupes and lavage also very useful. Careful postoperative treatment of diet, digestion, and bowel movement very essential prophylactically.

Adhesions a prolific source of obstruction. Can we prevent them? Not altogether. It is largely a matter of careful technic. Operate early, rapidly, yet carefully, avoid drainage. If drains necessary, the kind of drains and their position of great importance. Remove source of infection, avoid displacing of bowels, cover denuded peritoneum if possible, encourage early peristalsis and frequent change of position after operation. Can we prevent the reformation of adhesions? No, we may minimize them. Great variety of substance interposes between raw surfaces. No one a panacea. Many enumerated. Mucilage apparently the best.

Treatment of actual obstructions is *operative*.

Late Obstructions.—Ample incision over site of obstruction if known, otherwise exploratory. Operate early. Collapsed and distended coils guide to obstruction. Relieve cause. If gut not viable resect and anastomose.

Early Obstructions.—Palliation by enemata, physostigmine, lavage, etc., should not be persisted in too long. Most cases operated too late. If mechanical cause suspected, laparotomy and relief of cause. If paralytic obstruction, enterostomy with flushing and syphonage. Technic of enterostomy. Objections to enterostomy. It should be done earlier to avoid the present poor results. In the early obstructions prophylaxis has given best results and made them much less frequent.

DR. ALBERT J. OCHSNER, of Chicago, said that if immediately upon the appearance of nausea or gaseous distention gastric lavage be instituted there will be fewer instances of intestinal obstruction, following shortly after operation. As regards intes-

tinal obstruction due to conditions appearing many weeks after operation, his observation has been that he had practically no mortality excepting in those cases coming under treatment after having received cathartics.

DR. ALEXANDER H. FERGUSON, of Chicago, said, in regard to operative obstruction and the prevention of adhesions following operations, that for four years he had used subgallate of bismuth, smearing it over all raw surfaces, with most complete satisfaction.

DR. ARPAD G. GERSTER, of New York, said that if we want to make headway against obstructions caused by adhesions we must first know the cause of the adhesions, and this we do not know at present. Many causes have been exploited, the use of packings, the handling of the intestines, and other mostly traumatic lesions to the peritoneal coat, but we have seen in the presence of the greatest traumatism that could be inflicted on the intestine that adhesions did not form. Here the pathologist and experimental surgeon must come to our aid. He believed that the cause must be looked for in certain conditions of the blood of the patient.

ABNORMAL POSITION OF THE DUODENUM.

DR. G. E. ARMSTRONG, of Montreal, read a paper with this title, for which see page 111.

HEPATICODUODENAL ANASTOMOSIS.

DR. GEORGE E. BREWER, of New York, read a paper with this title, for which see page 830, June, 1910.

RESECTION OF THE PANCREAS.

DR. J. M. T. FINNEY, of Baltimore, read a paper with this title, for which see page 818, June, 1910.

DR. M. L. HARRIS, of Chicago, mentioned the case of a policeman who was shot by a 38 calibre bullet which entered just below the twelfth rib on the left side and was found just beneath the skin a little to the right of the median line between the eighth and ninth ribs. The track of the bullet from before backward was through the right lobe of the liver, the lesser curvature of the stomach, the middle of the pancreas practically bisecting the organ, and the left kidney. The stomach was sewed up, then the pancreas, and as close an approximation of parts made as

possible. Drainage front and back. Fistula resulted but closed in about three months and patient fully recovered.

DR. G. E. ARMSTRONG, of Montreal, with regard to the mobility of pancreatic tumors, mentioned a case in which there was a large pancreatic cyst which for a long time because of its mobility was considered to be a growth in the stomach.

DR. WILLY MEYER, of New York, said that he had had two cases in which the tail of the pancreas was tightly adherent to the existing tumor, and here he put a piece of chromicized gut around it and divided the distal end with the Paquelin cautery. Both patients recovered.

DR. RUDOLPH MATAS, of New Orleans, reported a case of thrombosis of the splenic artery incidentally involving the pancreatic arterial supply, causing degeneration of the organ from the head to the tail, associated with multiple tumor formation in the spleen. The spleen and three-quarters of the pancreas were removed and the patient recovered from the operation, dying about three years later from a slow fever.

VACCINE THERAPY AS AN ADJUNCT TO SURGERY.

DRS. JOHN B. DEAVER, JOHN C. DACOSTA, JR., and D. B. PFEIFFER, of Philadelphia, presented a paper with the above title, an abstract of which is as follows:

There has been established at the German Hospital a special department of Vaccine Therapy. In addition to its well-known and satisfactory use in suppurative affections of the skin and other forms of minor chronic infection, this form of treatment has been used as an adjunct in the treatment of more severe surgical infective conditions.

Vaccines did not prove of service in three cases of streptococcic septicæmia in which the treatment was begun late. Four cases of severe staphylococcic septicæmia recovered, improvement in each case beginning with the initiation of the vaccine treatment. Eight cases of severe septic intoxication without demonstrated bacteræmia were treated by drainage and vaccines. Two were *in extremis* when treatment was begun and died shortly afterwards. The remainder recovered. Five of the cases were streptococcic infections.

Improvement was also noted in a miscellaneous group of cases comprising persistent sinuses, cystitis, thrombosis, etc. Not all cases, however, gave a definite response. The dosage varied

from 25,000,000 to 750,000,000. The sicker the patient and the less satisfactory the response, the smaller and less frequent should be the dose. Streptococcus also was used in smaller dosage than staphylococcus.

On the basis of these results the paper concludes:

Specific vaccine treatment in our hands has not proved of benefit in the later stages of streptococcic septicæmia.

Staphylococcic septicæmia has been treated with most favorable results at all stages.

Septic intoxications without demonstrated blood invasion in a majority of the cases display general and local improvement under the use of vaccines if given early: the later the treatment, the less certain and satisfactory the result.

Localized and persistent suppurating lesions are sometimes markedly benefited by vaccines.

Surgical procedures for the relief of infectious conditions should be reinforced by vaccine treatment, which should be begun as early as is consistent with the case, and preferably by autogenous organisms.

No hospital can be considered fully equipped which is not prepared to supply this form of treatment in conjunction with established measures.

THERAPY BY BACTERINS AND TUBERCULINS IN MIXED SUPPURATIVE BONE AND JOINT DISEASE.

DRS. DEFOREST WILLARD and B. A. THOMAS, of Philadelphia, read a paper with the above title, for which see page 761, June, 1910.

DR. J. M. T. FINNEY, of Baltimore, in regard to the use of vaccines in chronic infections of the bladder from the colon bacillus, mentioned a case in which, after every other method had failed, injections were followed by the most astonishing results, the bladder symptoms all practically disappearing.

DR. WILLIS G. MACDONALD, of Albany, called attention to the extreme importance of not giving too large a dose of vaccines.

SURGEON-GENERAL STERNBERG, of Washington, said that it was impossible to doubt that vaccine treatment is beneficial in a certain class of cases, but it is difficult to understand why it should be. You have a certain specific micro-organism in the blood in large numbers, producing toxic products, and why the

introduction of a comparatively small number of the same micro-organisms under the skin should have such a potent effect in arresting the progress of the disease was to him inexplicable.

DR. L. L. McARTHUR, of Chicago, called attention to the tuberculin treatment in essential hemorrhage of the kidney. Treatment with the autogenous vaccine of the colon bacillus in several such cases has been productive of a cure.

DR. JOHN B. MURPHY, of Chicago, said that the essential hemorrhage of the kidney, the essential hemorrhage of the uterus occurring in girls under twenty with tuberculous histories, respond marvellously to proper dosage with tuberculin. Great assistance is rendered by this treatment in cases of bone tuberculosis. There is, however, no more treacherous and dangerous drug than tuberculin if improperly given. As a stimulant, and as an aid to surgical tuberculosis, he knew of nothing so good when the treatment is carefully administered.

DR. JOSEPH C. BLOODGOOD, of Baltimore, had had no experience in the vaccine treatment but suggested in regard to the essential hemorrhage of the kidney that a more simple serum be tried first. The Professor of Pathology at Tufts College has demonstrated the rapidity with which blood-serum of all animals will check hemorrhage, so perhaps it is some antibody in the serum and not the organism that checks the hemorrhage when tuberculin is used in these cases.

DR. JOSEPH A. BLAKE, of New York, had been employing the vaccine treatment pretty persistently, and in chronic infections had found the autogenous vaccines of great benefit.

DR. ARTHUR DEAN BEVAN, of Chicago, considered it too early at this time to arrive at any definite conclusions with regard to the value of this treatment. He had been particularly interested in the application of the vaccine treatment to tuberculosis of the kidney and mixed infection of tuberculosis of the colon, and although he knew of cases which under good management with this treatment had gone on to recovery, he also knew of cases which without the vaccine treatment also recovered.

DR. FRANCIS B. HARRINGTON, of Boston, said that he had seen some cases in which autogenous vaccines had been of great benefit, and also some cases in which they were productive of great harm.

DR. HARRY M. SHERMAN, of San Francisco, said they were using tuberculin more and more in the Children's Hospital.

With regard to the vaccine treatment, they had had no success with the streptococcus injection.

DR. EMMET RIXFORD, of San Francisco, mentioned a case of tuberculous anal fistula, tuberculosis of the spinal cord, and tuberculosis of the wrist which under treatment with tuberculin was completely restored to health. It has been two years since the treatment, there is now no sign of tuberculosis, and the patient has gained 40 pounds in weight.

THE STUDY OF THE ETIOLOGY OF CANCER BASED ON
CLINICAL STATISTICS.

DR. ISAAC LEVIN, of New York, read a paper with the above title, for which see page 768, June, 1910.

THE SIMULATION OF NEOPLASMS BY INFLAMMATORY
PROCESSES.

DR. C. A. HAMANN, of Cleveland, Ohio, read a paper with the above title, for which see page 782, June, 1910.

DR. HARRY M. SHERMAN, of San Francisco, reported an instance in which through a mistaken diagnosis he removed an inflammatory mass believing it to be sarcoma including the parotid gland. A radical operation was done, beginning with the clavicle, with removal of all the tissues up to and including the parotid gland, following the report on a section of the growth sent to the pathologist that it was probably of sarcomatous origin. When the whole mass was sent to the laboratory for examination, however, it was proven to be an inflammatory mass in the centre of which was a normal parotid gland. In the light, however, of no clinical symptoms of syphilis and a negative Wassermann, and a definite tumor mass, the evidence against syphilis in the diagnosis was enough to justify the operation for sarcoma.

WANDERING SPLEEN, WITH TWISTED PEDICLE, PRO-
DUCING A TUMOR IN THE PELVIS.

DR. A. MACLAREN, of St. Paul, Minn., read a paper with this title, for which see page 834, June, 1910.

DR. RUDOLPH MATAS, of New Orleans, in this connection reported two cases of misplaced spleen, one occurring in his own practice and one in the practice of a colleague. In both cases the spleen was lodged in the pelvis. In his own case there was a certain amount of peritonitis with two twists in the pedicle and beginning gangrene. The spleen filled the whole

pelvis. He removed the organ and the patient made a good recovery.

RESECTIONS OF THE RECTUM FOR CANCER.

DR. WILLIAM J. MAYO, of Rochester, Minn., read a paper with this title, for which see page 854, June, 1910.

DR. ARTHUR DEAN BEVAN, of Chicago, emphasized a point of technic based upon an experience with some twenty cases in which the Kraske operation was performed. That is, during the Kraske operation he did not employ a single ligature, but simply as he comes to the tissues on the sides of the incision freeing the rectum, massive 10 inch or 12 inch clamps are put on the tissues, for instance, high up on the levator ani muscles and on the inferior hemorrhoidal vessels which supply the rectum and the lower part of the sigmoid. With the employment of these clamps there is less risk of hemorrhage and a greater saving of time than if an attempt is made at ligation.

DR. JOSEPH C. BLOODGOOD, of Baltimore, said that in one of his first cases, operated on about six years ago, he was able to save three inches of the anus and rectum, making a suture with the sigmoid which was brought down, and this patient has not only been as well as before, but has perfect function.

DR. ALEXANDER H. FERGUSON, of Chicago, said that in some of his cases he had resorted to the combined operation in two stages to advantage. Open the abdomen, take the proximal end of the bowel, make an artificial anus, invert the distal end into the rectum—that would be one operation; then, when the patient is in good condition, remove the rectum from below, the bowel being already inverted giving ready access to the mass. By the use of clamps without ligatures the operation can be done in a few minutes.

DR. JOSEPH A. BLAKE, of New York, said that he had had more experience with the combined operation than with any other; he had done twelve consecutive operations in that way without any mortality. The mortality is less if a permanent colostomy is done; it avoids infection and the operative field is kept comparatively clean, and it also affords the opportunity of removing the whole growth at the lower part of the bowel. This procedure should be confined to those cases at the middle of the rectum or above, and those in which the anal sphincter is involved and has to be removed.

DR. G. E. ARMSTRONG, of Montreal, said that in the low cases where the sphincter has been involved he had sometimes succeeded in getting a satisfactory sphincter by bringing the upper ends down through the lower fibres of the gluteus maximus. One such case operated upon ten years ago now has perfect control.

DR. WILLIAM J. MAYO, of Rochester, Minn., in closing said that they had had some very satisfactory cases of union between the sigmoid and lower portion of the rectum, and the rule has been, when made from above it has been all right, but when made through the posterior incision, or through the vagina, there is ulcer and fistula. In regard to permanent colostomy, he had often regretted not having employed this procedure, because some of the deaths had been due to infection.

He emphasized the point that it is practically impossible to make honest percentages of cases such as these, for the reason that if all cases which cannot be traced are counted as dead the mortality rate would mount up. This is the only way, however, to consider the cases of which there is no absolute record, and proves the inaccuracy of any percentages which one may try to strike.

PROGNOSIS AND OPERATIVE TREATMENT OF FRACTURE OF THE BASE OF THE SKULL.

DR. JOSEPH RANSOHOFF, of Cincinnati, Ohio, read a paper with this title, for which see page 796, June, 1910.

DR. FRANK E. BUNTS, of Cleveland, said that in an ordinary case of fracture of the base of the skull in which the blood-pressure can be obtained, a beginning choked disc and œdema, and hemorrhage in the brain detected, the decompression operation should be performed, and in many such cases we may expect altogether beneficial results.

DR. JOSEPH C. BLOODGOOD, of Baltimore, said that up to the present time he had been unable to find any case of epilepsy following an injury to the skull in which some piece of the skull was removed, either by operation or by the injury itself. This would rather substantiate the view that epilepsy is more apt to be started up by changes in pressure than by actual injury.

DR. G. E. ARMSTRONG, of Montreal, said that if in these cases the pressure is subtentorial, as indicated by the respiration, aspiration of the cerebrospinal canal may prove very injurious.

Apropos to Dr. Bloodgood's remark, he knew two instances where epilepsy had followed in the presence of considerable defect in the skull; one following the kick of a horse in a young man, where there was rupture of membrane, loss of brain tissue with considerable defect in the skull remaining, and epilepsy beginning a couple of years later; the other, in a man injured in the frontal region in which there is a considerable defect in the skull, and epilepsy has followed.

A METHOD OF OVERCOMING THE SHORTENING IN OLD FRACTURES TREATED BY THE OPEN METHOD.

DR. EDWARD MARTIN, of Philadelphia, said that the major difficulty in the treatment of ununited fractures of the long bones, or those which have united with shortening so great as to be crippling, is incident to the difficulty in overcoming the shortening rather than to that of providing means for securing retention after this deformity has been once overcome; pegs, screws, plates, and lashings, supplemented by proper splinting, usually proving adequate for this latter end. A shortening which has lasted even for some weeks in, for instance, the femur, is so little influenced by practically any amount of traction that can be applied to the foot or leg that resection is often needful before the ends of the bone can be brought in proper relation to each other. This traction when applied by the hands of powerful assistants is intermittent and inefficient. When applied by the compound pulley it is vulnerating and likely to injure parts remote from the seat of injury. Moreover, when confined within safe limits, it is too often entirely inadequate. It was because of the complete futility of any method of traction which could be applied to the leg and foot in the case of an ununited fracture of the femur with $2\frac{1}{2}$ inches of shortening that the present method of overcoming the shortening was devised. It consists in a long strong canvas strip, pocketed in the middle and looped at the ends. The bones at the seat of fracture are freed, the pocket is slipped over the proximal end of the distal fragment, the ends of the canvas strip are carried in the long axis of the limb, and in the loops is fixed a cord to which are attached the weights. By thumb pressure the bone is kept from angling out of the wound, and weights up to 100 pounds, or even more, are attached to the rope. In from three to five minutes the shortening is overcome. Only those structures which interfere with proper

placement are stretched, and this is done so thoroughly that there is but slight tendency to the reproduction of deformity.

DR. RICHARD H. HARTE, of Philadelphia, said that in regard to extension he considered a pulley similar to that used on boats, a double and single pulley, to be the best type to use. These should not be close together, but enough line between them to allow of manipulation of the limb by the operator. After a thorough incision has been made and the ends of the bone exposed, one can disengage the bands of tissue by the employment of steel elevators. It is important to do as little damage as possible to the tissues. He did not consider silver plates strong enough to hold the bones in position and therefore would always advise the use of a heavy steel plate such as that suggested by Lane.

DR. ALBERT J. OCHSNER, of Chicago, described a method which consisted in the slow stretching of the muscles instead of the rapid stretching; the only thing that is peculiar about the method is the application of rubber adhesive strips to as high a point above the seat of fracture as is possible. For instance, instead of applying the rubber adhesive up to the fracture, it should be applied over the entire length of the thigh, then, with no more than 24 pounds of weight, he had, in every fracture where there had not been a union, been able to stretch the muscles sufficiently to replace the fractured ends without making a resection of them. In cases where there is a union in malposition, the muscles will stretch to a marked extent. It is important to use two Lane plates, with two screws at each end in order to keep the bones from slipping.

DR. JAMES E. THOMPSON, of Galveston, thought the important point to be that it is not the contraction of the muscles which prevents reduction; it is hemorrhage, and after this blood-clot has been evacuated the bones can be held in proper position.

DR. HARRY M. SHERMAN, of San Francisco, did not consider the method of extension described by Dr. Harte as good as where two hanks of yarn are applied as perineal straps, the weight coming on the tuberosity of the ischium. On the foot is put another hank of yarn. The pulling upon the bones has been measured, and over 200 pounds of weight have been applied in some cases without injury to the ligaments of the ankle or knee, and that is sufficient to pull out any tissue interfering with the approximation of the bones.

DR. EDWARD MARTIN, of Philadelphia, in closing said that

the length of the screws used in adjusting these plates should be the thickness of the bone; they should be threaded up to their heads, and to hold the plate in place it is required that they penetrate entirely through the bone and no more.

In cases of extension he preferred to use the old-fashioned resin plaster, properly made, because the rubber plaster always excoriates the skin.

FRACTURE DISLOCATIONS OF THE OS INNOMINATUM.

DR. HARRY M. SHERMAN, of San Francisco, Cal., read a paper with this title in which he made the point that simple uncomplicated fracture of the pelvic bones was not of necessity a serious lesion, but that healing could be expected in an ordinary way as after a fracture of a bone of an extremity; that the really serious lesion was the complication of injuries to the bladder, the intestines, or the vascular system; that injuries to the bladder were more likely to occur when the fracture had been due to anteroposterior compressive force; that injuries to the urethra were more apt to occur when the fracture was due to transverse compressive force; that the present indications were to open at once the space of Retzius and make a reverse catheterization and perineal section with lateral incisions in the groin and perineum for drainage of all areolar planes. With this technic the mortality should be reduced to about 33 per cent. as against 60 per cent.

DR. ARPAD G. GERSTER, of New York, said that he had had in his experience a case of fracture of the female pelvis on the left side in which there was no injury of the urethra, although it was compressed to such an extent by a solid blood-clot that retention followed and had to be relieved for fifteen or sixteen days by the use of the catheter. The woman recovered, there was no other injury present. Another case was one in which there was fatal hemorrhage following fracture of the pelvis. Post-mortem revealed extensive laceration of one of the common iliac arteries and subperitoneal hemorrhage.

MOMBURG'S METHOD OF ARTIFICIAL ANÆMIA BY SUPRAPELVIC CONSTRICTION.

DR. ARPAD G. GERSTER, of New York, read a paper with the above title, for which see page 878, June, 1910.

DR. JOSEPH RANSOHOFF, of Cincinnati, had seen this method

pursued in one case, and in this no ill effects resulted from its employment.

DR. HARRY M. SHERMAN, of San Francisco, suggested that where this method is used there is the same vasomotor paralysis below the point of constriction as after the employment of the ordinary Esmarch bandage on the extremities, and that this may be a reason for returning the vessels to the circulation gradually, otherwise there might be hemorrhage into the arteries.

DR. RUDOLPH MATAS, of New Orleans, had pursued some experiments among some students with this method, but found that a fair test of it could not be made unless the patient was anæsthetized in order to gain complete relaxation. From his very imperfect experiments, however, it was shown that in all weak hearts one is liable to have prompt failure; instead of noting the usual increase in blood-pressure, there will be a fall, and this indicates an inability on the part of the heart to keep up. He would not advise the use of the Momburg constrictor in any patients suspected of having any cardiac irregularity, but believed it will prove of great benefit in producing artificial anæmia in strong, robust individuals without being followed by any ill effects.

DR. ARPAD G. GERSTER, of New York, in closing specially emphasized the point that this constrictor is not indicated in cases in which there is any disturbance with the cardiac function. It has proven particularly valuable in postpartum hemorrhage in healthy individuals.

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